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COMPUTER ANALYSIS & LABORATORY EVALUATION
OF INTERACTION EFFECTS OF
COMBINED ENVIRONMENTS
ON SYNCHROS TYPE 23TX6

BY

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DA Project 5B98-09-004

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ABSTRACT

This project investigates the adaptability of an analytical evaluation method developed by J. S. Arnold of Stanford Research Institute [1., 2.] to automatic data processing systems techniques for prediction of combined environments interaction effects.

Laboratory tests were performed on some typical environmental combinations and results were compared with the ADPS predictions for the same environmental combinations.

For the test items selected, the experimental results showed substantial agreement with the analysis and predictions from the computer.

1. SYNERGISTIC EFFECTS IN COMBINED ENVIRONMENTS TESTING, by Mr. J. S. Arnold, Stanford Research Institute
2. EFFECTS OF COMBINED ENVIRONMENTS, by Mr. J. S. Arnold, Stanford Research Institute

GLOSSARY OF TERMS AND DEFINITIONS

Test Unit (TU)

The smallest part of a complex mechanism upon which any of the environmental factors have a significant effect.

Simple Environmental Factors (SEF)

The physical attributes of the real environment that directly act upon the state of a test unit.

Simple Unit Parameters (SUP)

Those states of the test unit in which variations can be expected as the result of the forcing influences of the environment factor.

Electro-Magnetic State (EM)

The electric and magnetic conditions that exist in the TU, which may be either steady or fluctuating. Variables: voltage, current, magnetic flux, inductance, resistance, capacitance, field strength, hysteresis.

Strain State (STN)

The deformation produced by the stresses to which the TU is subjected, including the effects of internal stresses. Variables: deformation, shape, dimensions, compression, extension, distortion, expansion.

Elastic State (ELAS)

Includes the behavior properties of the TU with respect to deformation under steady or cyclic forces. Variables: Young's modulus, bulk modulus, loss, complex elastic modulus, spring constant, damping, shear modulus.

Chemical State (CHEM)

The reactions include the slow ones of normal aging as well as the fast ones that describe the operation of chemically active devices. Variables: composition, reaction rate, contamination, ph, energy release (or absorption), reaction products.

High Temperature (Th)

Any environment condition that causes sensible heat input to the TU, so that its temperature approaches the design range maximum. Includes heat input by conduction, convection, radiation, condensation of hot vapor, etc.

Low Temperature (T_l)

Any environment condition that causes sensible heat outflow from the TU, so that its temperature approaches the design range minimum. It includes heat outflows by conduction, convection, radiation, evaporation, etc.

Changing Temperature (Tc)

Any environment condition that causes sensible heat in- or outflow at a rate that approaches the design maximum. It includes such thermal situations as quenching, blast heat input, electrical discharge, violent chemical reaction, all forms of thermal shock.

High Pressure (Ph)

Any environment condition in which pressure that approaches the design range maximum is exerted on the TU. It includes air pressure, gas pressure, hydrostatic pressure, spring pressure.

Low Pressure (Pl)

Any environment condition in which low pressure, approaching the design minimum, is exerted on the TU. It includes low atmospheric pressure, relief of normal pressurization, high altitude effects.

Changing Pressure (Pc)

Any environment condition that causes pressure change at a rate near the design maximum for the TU. Includes blast effects, shock phenomena, explosive decompression, cavitation.

Ionizing Radiation (Ri)

Any environment situation in which ionizing radiation is an input to the TU. Includes bombardment by X-rays, gamma rays, cosmic rays, ultra-violet radiation and the various charged and uncharged particles that can produce ionization.

Mechanical Interference (Im)

Any environment situation in which components that are not properly a part of the TU can interfere mechanically with its operation. Includes dirt and dust accumulation, moisture condensation, biological material, mud, ice, snow, frost.

Relative Acceleration (Ar)

Any environment situation in which the TU is accelerated with respect to its surroundings, to produce forces that are near the design range maximum. Includes effects due to steady or varying acceleration, solid and airborne sound and vibration, wind and slipstream, propulsive thrust, drag, particle impingement.

Electric-Magnetic Fields (Fd)

Any environment situation in which the TU is subjected to steady or alternating electric or magnetic fields or electromagnetic radiation, the electric or magnetic effects of which approach the TU design range maximum. Includes fields from electric machines, electrostatic charge, magnets, coils, radiation from radar and communication apparatus.

Surrounding Chemical Composition (Cs)

Any environmental situation in which the chemical reaction potential of the surroundings (atmosphere, liquids and solids in contact with TU) approaches the TU design range maximum. Includes contaminated atmospheres, effects of chemical pollutants.

Time (Zt)

An environmental situation in which there exists a time-dependent component in the definition of the design ranges of the parameters describing a test unit.

COMPUTER ANALYSIS AND LABORATORY EVALUATION OF INTERACTION EFFECTS OF COMBINED ENVIRONMENTS ON SYNCHROS, TYPE 23TX6

INTRODUCTION

This report covers work done at Frankford Arsenal in the continuation of research efforts previously performed by Stanford Research Institute under Contract DA-04-200-ORD-1032 and DA-04-200-ORD-1141, Department of Army Project No. 5B98-09-004, under the sponsorship of Mr. P. W. Espenschade, Chief, Environmental Research Office, Army Ordnance Corps (now Army Materiel Command).

Two previous reports have been published on this subject: "SYNERGISTIC EFFECTS IN COMBINED ENVIRONMENTS TESTING" and "EFFECTS OF COMBINED ENVIRONMENTS", both prepared by Mr. J. S. Arnold, Stanford Research Institute, Menlo Park, California. The reports describe a method of analysis utilizing automatic data processing machines to permit better prediction of the effects of interaction of two or more environmental factors on the functioning of Army materiel. The work was analytical rather than experimental and had as its objective the treatment and analysis of the interactions of two or more environmental factors and their effects.

The analysis involves the <u>states</u> that describe a test unit, the measurable physical <u>parameters</u> necessary to describe each of the states, the <u>environmental factors</u> that can be used to describe the environments, and the measurable physical parameters affected by each of the environmental factors. The proposed computer application of the analysis was developed in detail to a stage whereby a step-by-step procedure from input data (real environment and test unit descriptions) to output data (the environment action possibilities) can be traced.

The continuation of the research, herein reported, was performed jointly, by Mr. J. Arnold of Stanford Research Institute and Mr. M. H. Simpson of Frankford Arsenal under Department of Army Project No. 5B98-09-004. Machine analysis methods were set up for environmental interaction problems and solved with the use of a computer. Experimentation was performed to compare test results with the computer solutions.

OBJECT

To determine the interaction effects of vibration and low temperature, altitude and low temperature, and temperature and humidity on Transmitter, Torque, Synchros Type #23TX6 as a Test Unit (TU), and compare the test results obtained in the environmental laboratory with computer predictions programmed on a Remington Rand Solid State 90 Computer, in accordance with the analysis method developed by the Stanford Research Institute.

PROCEDURE

The selected test unit (TU) was a Transmitter, Torque, Synchro, Type #23TX6 shown in Figures 1 and 2. There were three phases of effort in the study. The first phase consisted of a Parts Analysis such as shown in Appendix 1, Sheets No. 1 thru 5. The second phase consisted of a computer program set up in accordance with the procedure outlined in Appendix 2, REQUIREMENTS FOR DATA ANALYSIS, SYNERGISTICS STUDY OF ENVIRONMENTAL INTERACTIONS, and Appendix 3, CATALOG A input and Appendix 4, CATALOG B input. The third phase was environmental laboratory testing for comparison of test results with qualitative computer solutions.

Phase 1. The parts analyses sheets were prepared as illustrated in the Appendix, to predict what Simple Unit Parameters (SUP's) might be affected by environmental action on that part.

Phase 2. For the computer phase, punched cards were used to set up the memory in a Remington Rand Solid State 90 Computer.

The following problems were given to the computer to predict:

a. low temperature and altitude combined effects

b. high temperature and high humidity combined effects

c. vibration and low temperature combined effects

The data was submitted to the computer in accordance with the method developed by Stanford Research Institute; i.e.:

Given the TU (Test Unit = Synchro Type 23TX6).

and the following SUP's (Simple Unit Parameters) important to it in the environments concerned (See Glossary of Terms and Definitions):

EM	=	Electric-Magnetic State
STN	=	Strain State
ELAS	=	Elastic State
CHEM	=	Chemical State

and the effects:

I	-	Indirect effect of one environment.
ID	-	Indirect effect of one environment and direct effect of the second environment.
D^2	-	Direct effect of two environments.
I^2	-	Indirect effect of two environments.
O	-	No effect.

What effects can be expected from the combined SEF (Simple Environmental Factors) indicated below?

a. Vibration and Low Temperature - ArTl

b. Altitude and Low Temperature - PlTl

c. Humidity and High Temperature - CsTh

Phase 3 - The test phase consisted of subjecting the synchros to combined environments testing to the same combinations presented to the computer; i.e., Vibration and Low Temperature, Altitude and Low Temperature, and Humidity and High Temperature.

The environmental laboratory tests and the computer operations were performed at Frankford Arsenal.

DESCRIPTION OF COMBINED ENVIRONMENTS TESTING

Testing was performed during the period from August 1962 to October 1962. The Transmitter Torque Synchros, Type 23TX6, were electrically energized while being submitted to the following environmental conditions: Vibration and Low Temperature, Altitude and Low Temperature and High Temperature and Humidity. The test items were monitored for temperature changes, electrical continuity and for indications of arcing and/or short circuiting before, during, and after each test.

Vibration and Low Temperature Test #1
(Not Rotating)

The test set-up for the Vibration and Low Temperature Test (Figure 3) included the following pieces of equipment: LAB Type 24-200 Vibration Machine; Leeds & Northrup Speedomax multi-point temperature recorder, with copper-constantan thermocouples; Minneapolis-Honeywell Visicorder, Model 1108, Serial No. 11-164 an Endevco Model 2213 Accelerometer, 1½ Volt DC batteries, 45° synchro test fixture, and a liquid CO_2 portable cold chamber over the vibration machine. (See Figure 3).

Each of the three synchros was fastened to a 45° inclined fixture and the fixture was bolted to the vibration table. Thermocouples were placed on each synchro and in the air stream adjacent to the synchros. A continuous record of the temperatures was obtained by the Speedomax recorder. An accelerometer was fixed to the test fixture and the synchros' rotors were energized with 1½ Volts D. C. without rotation. Records of acceleration and electrical continuity were obtained by the M-H Visicorder.

The liquid CO_2 refrigerated cold chamber was then placed over the set-up. The synchros were then subjected to -40°F and vibration characteristics of; (a) double amplitude - 0.141 inches vertical vibration, (b) variable frequency - 5 cps to 60 cps to 5 cps (c) a total scanning time of one minute for (d) a time duration of eight hours. The synchros were energized with 1½ Volts D. C. before, during, and after the -40°F test. (See Figures 5 and 6). The test items were monitored for temperature change, vibration and electrical continuity, continuously. Figure 4 shows the electrical schematic of the test set-up.

Vibration and Low Temperature Test #2
(Rotating)

The environmental test characteristics were the same as for Test #1; i.e. synchros were subjected to -40°F and vibration characteristics of 0.141 inches double amplitude vertically, with a sweep of frequency from 5 cps to 60 cps to 5 cps in a scanning time of one minute, for a total period of 6 hours.

The vibration machine and temperature test chamber were identical to those used for Vibration and Low Temperature Test #1. In this test, however, the investigation of electrical characteristics was different. Four Synchros, Type 23TX6 were used for the test. Two synchros were used as driving units, mounted outside the cold box vibrator system and were electrically inter-connected with two additional Type 23TX6 Synchros mounted on the vibration machine and subjected to the vibration and low temperature environments. The driving synchros were, in turn, revolved by small motors thru flexible shaft combinations at 57 rpm and 60 rpm respectively. The follower, or driven synchros were positioned by the driving synchros. Electrical output of the driving synchros was 115 volts; resulting amperage was in accordance with data in Figure 8 and Appendix 7. Figure 7 shows the electric schematic of driver-driven synchro system.

Altitude and Low Temperature Test

The electrical measurements and test set-up for the Altitude - Low Temperature Test and the High Temperature - Humidity Test #1 were identical. (See Figures 4 and 9). Equipment used in these tests included: an altitude-temperature-humidity chamber, 45° synchro test fixture, copper constantan thermocouples, Esterline Angus Recording Ammeters, Model 4W, Serial Nos. 45846, 124180, 104091 (for electrical continuity), Foxboro Stabilog Pressure Controller (altitude test only), L&N Speedomax Multipoint Temperature Recorder, Minneapolis-Honeywell Wet Bulb Temperature Recorder (humidity test only), and a 6 volt All-State 48 battery.

The synchros were mounted on the 45° test fixture and placed in the chamber. Thermocouples were placed on each synchro and in the air stream. Temperature records were obtained by the Speedomax Recorder. The items were energized by 6 volt D. C. and monitored by the Esterline Angus Recording Ammeters.

For the Altitude and Low Temperature Test, the altitude in the chamber was maintained at 10,000 feet (20.58 inches Hg absolute) by a pressure controller, while the temperature was held at -65°F. The synchros were energized with 6 volts D.C. before, during, and after the test. The test items were monitored continuously for both temperature and electrical continuity. This test had an 8 hour time duration.

Temperature and Humidity Test #1

The Temperature and Humidity Test #1 was performed with a temperature of 125°F and a relative humidity of 95% for a period of eleven days. During this time, records of temperature and humidity were taken continuously. The Synchros, Type #23TX6, were energized without rotation by 6 volts D. C. before, during and after the entire test and they were monitored for electrical continuity a minimum of one hour each morning and one hour each afternoon, taken at random times.

Temperature and Humidity Test #2

The Temperature and Humidity Test #2 differed from the Temperature and Humidity Test #1 by the method of electrical testing and length of test. The second test had the driver-driven combination of Type 23TX6 Synchros set up for Vibration and Low Temperature Test #2. All other requirements were the same as Temperature and Humidity Test #1; i.e., 125°F and 95% relative humidity, but for 5 days duration. Chamber temperature and humidity data were taken continuously during the test and the TU temperature and current drain were monitored for a period of 15 minutes each hour of the normal working day for the duration of the test.

RESULTS

Automatic Data Processing

The computer program was set up and the memory was stored in punched cards from Catalog A, Real Environmental Classifications, and Catalog B, Macro, Micro, Status Locations. (See Appendices 3 and 4). At no time did the operator time lapse amount to more than two minutes. Initial programming time amounted to four man days. (See Appendix 2 for programming requirements).

The computer solutions and predictions of combined effects on the Synchros, Type 23TX6 were as follows:

1. Combined Effects of Vibration and Low Temperature: - that there would be an effect in strain and electrical properties of the test unit; i.e., ID effect.

2. Combined Effects of Low Temperature and Altitude: - that there would be an effect in electrical and strain properties of the test unit, i.e., D^2 effect.

3. Combined Effects of High Temperature and High Humidity: - that there would be an effect in chemical and electrical properties of the test unit; i.e., ID effect.

Environmental Tests

Vibration and Low Temperature Test #1

There was considerable arcing at normal room temperature with vibration in the frequency range of 35-60-35 cps, which was observed both visually and on the electrical monitoring records. With the addition of low temperature (-40°F) a noticeable reduction in arcing occurs, as seen in Figure 6. The remaining arcing appears in the frequency range of 45-60-45 cps. Figures 5 and 6 show the results of vibration at room temperature and vibration with low temperature.

Vibration and Low Temperature Test #2

There was no change of amperage indicated in running current for both test units when exposed to -40°F air temperature as compared with operating amperage at normal ambient temperatures. Appendix 5 is the tabulated data and Figure 8 the plotted data of vibration at ambient and vibration at low temperature.

Altitude and Low Temperature

There is a definite increase in current drawn as the temperature decreases. It took the synchros 2 hours to stabilize at -65°F. During this time, the values of current drawn increased from 48 ma, 65 ma, and 63 ma (at ambient) to 87 ma, 106 ma, and 102 ma for synchros 1, 2, and 3 respectively. The changes in current drawn were 39, 41, and 39 ma. Since the voltage was held constant, an increase in current drawn indicates a decrease in electrical resistance. Figures 10 and 11 and Appendix 6 show the effects on electrical continuity of the synchros during the altitude - low temperature test.

High Temperature and High Humidity Test #1

With the test chamber temperature and humidity at 125°F and 95% relative humidity there was an immediate increase in current drawn by synchro #1 (from 50 to 58 ma) while synchros #2 and #3 decrease in current draw (from 65 to 59 ma for #2 and 63 to 57 for #3). After 1½ days of the test the current draw of all three synchros stabilized and showed a definite increase in milliamperes. The final values of current were 62, 69, and 68 ma for synchros #1, #2 and #3. At one period during the test the chamber door was opened to see if any visual corrosion had taken place. While the door was open it was noticed that moisture had formed on the inside of the clear plastic top of synchros #1 and #3. When these test items were removed from the test fixture, it was noted that the rotors were locked tight. This was probably caused by corrosion due to humidity. This was later verified by disassembly of the synchros. There was corrosion of the ball bearings and raceway, and some corrosion on the brush contact points noted. Figure 12 and Appendix 7 exhibit the experimental data for this test.

High Temperature and Humidity Test #2

Results of this test show that running current increased by 2 amperes for 1 test unit, and 4 amperes for the second test unit, at 125°F and 95% relative humidity. There was some erratic functioning of one test unit (Synchro #4) noted at 4 different times. Corrosion was noted similar to High Temperature and Humidity Test #1, including locked rotors, corrosion of the ball bearings and raceway, and some corrosion of the brush contact points. Figure 13 and Appendix 8 exhibit the experimental data for this test.

ANALYSIS OF RESULTS

The following tabulated comparison of the results of the ADPS and experimental findings should be analyzed in terms of effects:

Table #1

Automatic Data Processing

	D^2	ID	I^2
Vibration and Low Temperature		X	
Low Temperature and Altitude	X		
High Temperature and Humidity		X	

In order to check test results Table #2 is necessary:

Table #2

Experimental Effects

	Electrical Effect	Strain Effect	Corrosion Effect
Vibration and Low Temperature	X	X	
Low Temperature and Altitude	X	X	
High Temperature and Humidity	X	X	X

In order to compare experimental results with ADP results, it is necessary to transpose Table #2 into ADP factors:

Table #3

Experimental in ADP Factors

	D^2	ID	I^2
Vibration and Low Temperature	X	X	
Low Temperature and Altitude	X		
High Temperature and Humidity	X	X	

Note: X signifies occurrence.

From the foregoing data there is apparently some lack of agreement in the results of the automatic data processing prediction and experimental results. Comparing results in Table 3 (Experimental in ADP Factors) with results in Table 1 (Automatic Data Processing) D^2 effects were not predicted by the computer for two of the three test conditions but did occur for all three during the experiment. These D^2 effects occurred in the Vibration and Low Temperature Tests and the High Temperature and Humidity Tests. There was agreement in all other occurrences.

It should also be noted that the experimental results indicated a direct effect of temperature on current flow (due to resistance changes in the windings) as well as an indirect effect of temperature causing current changes (due to mechanical strain producing a relative change in spring contact resistance).

Comparison of experimental results with computer predictions revealed that:

1. Most of the effects observed after the combined environments tests were predicted by the computer analysis.

2. No combined environmental effects were found which the analysis indicated to be impossible.

3. The computer did not distinguish between the direct effect (D) and the indirect effect (ID) of a single environment on different parameters.

4. The computer did not evolve a double effect (D^2 and ID) as being inherent in the Vibration and Low Temperature, and High Temperature and Humidity Tests, but predicted only that there would be an indirect effect.

Note: The inconsistencies of paragraph 3 and 4 are probably due to incomplete parts analyses made by the analyzer in preparation of Catalogs A and B, and not necessarily a fault of the method.

CONCLUSIONS

The general conclusion of the investigation, based on the experimental findings, is that the proposed method of analysis and use of computers has merit for environmental evaluation of military materiel. The objective was to test the method. The effects observed could be beneficial or deleterious. The purpose was not to evaluate "good-or-bad", but to predict an effect; and this was demonstrated.

It may be possible that quantifying values could be applied to measure effects on parameters. However, further refinements on the qualified effects, especially relative to the prediction of direct and indirect effects of single and combined environments, should be made first before quantifying effects should be attempted. It is further concluded that additional investigation is warranted in pursuing this environmental evaluation and analysis method in order to determine whether a quantifying system could be attainable.

RECOMMENDATIONS

Since there is indication that benefits can be attained in the form of increased materiel reliability and reduced material cost by supplementing and/or replacing portions of environmental testing by analytical procedures, the use of analytical techniques with computer storage and manipulation of data will have great utility, especially in the prediction of combined environments effects. Analysis of data relating environments to test unit effects would be of considerable value in the determination of which environmental factors are important for the evaluation of a test unit and the reduction of requirements for testing.

The information required in environmental effects analysis is generally available, at present, in the form of texts, tables, books, reports, the experience of individuals, etc., but it is so scattered that all pertinent data are not usually brought to bear on a specific problem because of the magnitude of the task of assembling and using it. The machine analysis approach to the environmental problem is that of acquiring all the data in general form and storing it in the machine memory. An incoming problem can then be placed in such a format that all pertinent data in the machine's memory will be searched out and qualitative and quantitative aspects of the actions of environmental forces upon the materials and mechanisms will be determined more rapidly.

It is recommended that consideration be given to amplifying the investigation into a wider scope of effort. The suggested effort would include the following activities:

1. Automatic Data Processing Systems should be further studied for application to the environment-materiel interaction problem primarily to determine their capability for manipulating the data.

2. The present descriptions of climatic, geographic, and induced environments should be studied and methods for transforming these descriptions into the terms necessary for application to Automatic Data Processing should be developed.

3. The physical characteristics of materiel that are affected by environmental phenomena should be studied in order to define success and failure criteria for military operations.

4. Methods for the acquisition of data describing field materiel failures, and the cataloging and storage of these data for application to future problems, should be studied and evaluated for application for environmental factors.

5. The development of the analytical format in which the information is to be used should be continued as the information fund increases in size and scope.

APPENDIX 1

Part Analysis Sheet

Sheet No. 1

P. No. 7645534 TU No. 1 $\overline{\text{SUP}}$

P. Name Front End Bell

P. Function Support Bearing, Close Synchro

	Induced Environment Factors Caused by P None	No	Yes
CHEM	PO require chemical reaction?	X	
	External surface reactions (corrosion, rust) affect PO?	X	
	Volume reaction (displacement,solution) affect PO?	X	
	Slow (aging) reaction affect PO?	X	
CLN	Contaminants affect cooperation with other P?	X	
	Necessary thermal behavior impaired by contaminants?	X	
	Necessary surface characteristics (optical, electrical) impaired?	X	
ELAS	P has vibration isolation function?	X	
	P has strain relief function?	X	
	P has function of protecting other P?	X	
	PO require specific spring constant?	X	
EM	PO require EMF or MMF from P?	X	
	Can external E or M fields affect PO?	X	
	PO require specific electrical properties?	X	
	PO require specific magnetic properties?	X	
RHEO	PO require specific viscosity of P?	X	
	PO depend on circulation of P?	X	
	Cold or slow flow of P affect PO?	X	
	Viscous damping by P affect PO?	X	
STN	Steady or cyclic external strain on P affect PO?	X	
	Body force (steady or cyclic) on P affect PO?	X	
	Direction of gravity affect PO?	X	
	Strain-sensitive alignment of P affect PO?	X	
STR	Can state change occur in P to affect PO?	X	
	PO dependent on microstructure of P?	X	
	Allotropic changes in P affect PO?	X	
	Polymerization changes in P affect PO?	X	
	Surface structure changes in P affect PO?		
THER	Temperature of P affect PO?	X	
	Heat generation in P affect PO?	X	
	Heat conversion in P affect PO?	X	
	Heat transfer in P affect PO?	X	

Note: P = Part, PO = Part Operation

Part Analysis Sheet

Sheet No. 2

P. No. 583474 TU No. [illegible] SUP

P. Name Retaining Ring ELAS

P. Function Hold Closure in Place STN

Induced Environment Factors Caused by P	None	No	Yes
CHEM	PO require chemical reaction?	X	
	External surface reactions (corrosion, rust) affect PO?	X	
	Volume reaction (displacement, solution) affect PO?	X	
	Slow (aging) reaction affect PO?	X	
CLN	Contaminants affect cooperation with other P?	X	
	Necessary thermal behavior impaired by contaminants?	X	
	Necessary surface characteristics (optical, electrical) impaired?	X	
ELAS	P has vibration isolation function?	X	
	P has strain relief function?	X	
	P has function of protecting other P?	X	
	PO require specific spring constant?		X
EM	PO require EMF or MMF from P?	X	
	Can external E or M fields affect PO?	X	
	PO require specific electrical properties?	X	
	PO require specific magnetic properites?	X	
RHEO	PO require specific viscosity of P?	X	
	PO depend on circulation of P?	X	
	Cold or slow flow of P affect PO?	X	
	Viscous damping by P affect PO?	X	
STN	Steady or cyclic external strain on P affect PO?		X
	Body force (steady or cyclic) on P affect PO?	X	
	Direction of gravity affect PO?	X	
	Strain-sensitive alignment of P affect PO?	X	
STR	Can state change occur in P to affect PO?	X	
	PO dependent on microstructure of P?	X	
	Allotropic changes in P affect PO?	X	
	Polymerization changes in P affect PO?	X	
	Surface structure changes in P affect PO?	X	
THER	Temperature of P affect PO?	X	
	Heat generation in P affect PO?	X	
	Heat conversion in P affect PO?	X	
	Heat transfer by P affect PO?	X	

Part Analysis Sheet

Sheet No. 3

P. No. 8570216 TU No. 1 SUP

P. Name Ball Bearing CHEM CLN

P. Function Support Rotor STN

Induced Environment Factors Caused by P None

		No	Yes
CHEM	PO require chemical reaction?	X	
	External surface reactions (corrosion, rust) affect PO?		X
	Volume reaction (displacement, solution) affect PO?	X	
	Slow (aging) reaction affect PO?	X	
CLN	Contaminants affect cooperation with other P?		X
	Necessary thermal behavior impaired by contaminants?	X	
	Necessary surface characteristics (optical, electrical) impaired?	X	
ELAS	P has vibration isolation function?	X	
	P has strain relief function?	X	
	P has function of protecting other P?	X	
	PO require specific spring constant?	X	
EM	PO require EMF or MMF from P?	X	
	Can external E or M fields affect PO?	X	
	PO require specific electrical properties?	X	
	PO require specific magnetic properties?	X	
RHEO	PO require specific viscosity of P?	X	
	PO depend on circulation of P?	X	
	Cold or slow flow of P affect PO?	X	
	Viscous damping by P affect PO?	X	
STN	Steady or cyclic external strain on P affect PO?		X
	Body force (steady or cyclic) on P affect PO?	X	
	Direction of gravity affect PO?	X	
	Strain-sensitive alignment of P affect PO?	X	
STR	Can state change occur in P to affect PO?	X	
	PO dependent on microstructure of P?	X	
	Allotropic changes in P affect PO?	X	
	Polymerization changes in P affect PO?	X	
	Surface structure changes in P affect PO?	X	
THER	Temperature of P affect PO?	X	
	Heat generation in P affect PO?	X	
	Heat conversion in P affect PO?	X	
	Heat transfer by P affect PO?	X	

Part Analysis Sheet

Sheet No. 4

P. No. 8570257 TU No. 1 $\overline{\text{SUP}}$

P. Name Rotor Assy CHEM CLN EM

P. Function Rotate in Field STR THER

Induced Environment Factors Caused by P	H Field in Stator	No	Yes
CHEM	PO require chemical reaction?	X	
	External surface reactions (corrosion, rust) affect PO?		X
	Volume reaction (displacement, solution) affect PO?	X	
	Slow (aging) reaction affect PO?	X	
CLN	Contaminants affect cooperation with other P?		X
	Necessary thermal behavior impaired by contaminants?	X	
	Necessary surface characteristics (optical, electrical) impaired?		X
ELAS	P has vibration isolation function?	X	
	P has strain relief function?	X	
	P has function of protecting other P?	X	
	PO require specific spring constant?	X	
EM	PO require EMF or MMF from P?		X
	Can external E or M fields affect PO?		X
	PO require specific electrical properties?		X
	PO require specific magnetic properties?		X
RHEO	PO require specific viscosity of P?	X	
	PO depend on circulation of P?	X	
	Cold or slow flow of P affect PO?	X	
	Viscous damping by P affect PO?	X	
STN	Steady or cyclic external strain on P affect PO?	X	
	Body force (steady or cyclic) on P affect PO?	X	
	Direction of gravity affect PO?	X	
	Strain-sensitive alignment of P affect PO?	X	
STR	Can state change occur in P to affect PO?	X	
	PO dependent on microstructure of P?	X	
	Allotropic changes in P affect PO?	X	
	Polymerization changes in P affect PO?		X
	Surface structure changes in P affect PO?	X	
THER	Temperature of P affect PO?		X
	Heat generation in P affect PO?		X
	Heat conversion in P affect PO?	X	
	Heat transfer by P affect PO?	X	

Part Analysis Sheet

Sheet No. 5

P. No. 7595533 7595541 TU No. 1 $\overline{\text{SUP}}$

P. Name Brush Assy CLN ELAS EM

P. Function Contact Slip Rings STN

Induced Environment Factors Caused by P None		No	Yes
CHEM	PO require chemical reaction?	X	
	External surface reactions (corrosion, rust) affect PO?	X	
	Volume reaction (displacement, solution) affect PO?	X	
	Slow (aging) reaction affect PO?	X	
CLN	Contaminants affect cooperation with other P?		X
	Necessary thermal behavior impaired by contaminants?	X	
	Necessary surface characteristics (optical, electrical) impaired?	X	
ELAS	P has vibration isolation function?	X	
	P has strain relief function?	X	
	P has function of protecting other P?	X	
	PO require specific spring constant?		X
EM	PO require EMF or MMF from P?	X	
	Can external E or M fields affect PO?		X
	PO require specific electrical properties?		X
	PO require specific magnetic properties?	X	
RHEO	PO require specific viscosity of P?	X	
	PO depend on circulation of P?	X	
	Cold or slow flow of P affect PO?	X	
	Viscous damping by P affect PO?	X	
STN	Steady or cyclic external strain on P affect PO?		X
	Body force (steady or cyclic) on P affect PO?	X	
	Direction of gravity affect PO?	X	
	Strain-sensitive alignment of P affect PO?		X
STR	Can state change occur in P to affect PO?	X	
	PO dependent on microstructure of P?	X	
	Allotropic changes in P affect PO?	X	
	Polymerization changes in P affect PO?	X	
	Surface structure changes in P affect PO?	X	
THER	Temperature of P affect PO?	X	
	Heat generation in P affect PO?	X	
	Heat conversion in P affect PO?	X	
	Heat transfer by P affect PO?	X	

APPENDIX 2

REQUIREMENTS FOR DATA ANALYSIS

SYNERGISTICS STUDY OF ENVIRONMENTAL INTERACTIONS

The numerical entries of Catalog A and Catalog B are to be stored in the computer memory as tables, subject to withdrawal and readout when requested in accordance with certain conditions. The Catalog A entries consist of a variable number of digits, up to a maximum of 16, which refer to simple environmental factor (SEF), and the real environments in which they are found. The real environment code is on the first page of Catalog A, and the SEF code on the first page of Catalog B. (See Appendices 3 and 4).

A typical Catalog A entry might be as follows:

12	22	11	01	02	11	12
Macro Location	Micro Location	Status	SEF_1	SEF_2	SEF_{11}	SEF_{12}
			(Ar)	(C_s)	(T_e)	(Z_t)

The first 3 pairs denote the real environment (Arctic, in a surface vehicle, under cover) and the last four pairs denote the simple environment factors that are operating (acceleration, non-standard chemical surroundings, low temperature, and aging).

Catalog B entries consist of four two-digit pairs. The first two of these indicate the two SEF that are considered. The third pair denotes the state (SUP) of the test unit upon which the SEF acts, and the fourth pair indicates the type of effect. As an example, such an entry might be:

02	09	07	02
SEF_1	SEF_2	SUP	Effect
(C_s)	(T_c)	(STR)	I^2

The first 2 pairs indicates the two SEF (chemical surroundings and changing temperature). The third pair indicates the strain state of the test unit, and the fourth pair indicates an I^2 (or least probable) effect.

Simplest Operation (1)

The simplest operation will be the readout of entries in the above catalogs. For example, the operator may wish to know the SEF corresponding to a given real environment. He therefore asks for a readout of the entry corresponding to a real environment. He thus puts in an instruction to readout the Catalog A entry beginning with the six digits that correspond to the real environment. Similarly with Catalog B, in which case his instructions might be to print out an 8 digit entry, of which 6 digits are known. In some cases only four or perhaps two of the digits will be known, and the resulting readout must include all the entries that contain these digits in the specified positions.

Instruction: Readout the entry beginning

XXYYZZ????----

CATALOG A

Readout

Instruction: Readout the entry(s) that have

XX??ZZ??

CATALOG B

Readout

2nd Operation (Problem)

This operation is one in which a real environment (RE) is given, and the important state of a test unit (SUP) is given, and it is desired to find how the RE affects the SUP. The following steps are indicated:

(1) Find the SEF that describes the real environment by supplying the real environment code number (6 digits) and instructing the machine to find the SEF code numbers from Catalog A.

(2) Form all possible pairs of these code numbers (4 digit groups). It is hoped that this operation can be done in the machine, but it can be done by the operator after a readout if there is no better way.

(3) Take each 2 SEF pair, search Catalog B, find the pair or the first four digits of an entry, apply the condition that the given SUP code number be the 3rd pair of the entry. When this condition is satisfied, print out the complete Catalog A and Catalog B entries.

Instructions: Find the Cat. A entry corresponding to the given R. E. code XXYYZZ----.

CAT. A

Transfer to Register

Form all possible pair combinations of codes (7,8), (9,10), (11,12), (13,14), (15,16)

CAT. B. (Given SUP Code No.)
With each combination (4 digits) search Cat. B for coincidence of 1st four digits of Catalog entries. When coincidence is found, if digits 5 and 6 are the same as the given SUP code digits, print out the Cat. A entry and the Cat. B entry. If no coincidences, go on to next pair.

If no pairs, end of problem.

In the step that leads to the above readout, it would be desirable to include still another condition - the coincidence of the last two columns of the Catalog B entry with a given value. This would enable operator to get only a print out of the environmental effects of a prescribed kind (01, 02, 03, or 04).

3rd Operation

Given a TU and the SUP important to it. What real environments will affect it?

Instructions:

CAT. B.

With the given SUP code search and print out all Cat. B. entries that have this code number in columns (5,6) and 02, 03, or 04 in columns (7,8).

CAT. A.

Using the resulting SEF pair columns (1,2), (3,4), search Cat. A columns (7,8), (9,10), (11,12), (13,14), (15,16). When coincidences are found, print out the entire Cat. A entry.

APPENDIX 3

Catalog A

Real Environment Classification

	Macro-location	CODE	Micro-location	CODE	Status
10	Arctic		Stationary		Z of I
11	Ice Cap	11	In Open	11	Storage-Boxed
12	Inland	12	Overhead Shelter	12	Storage-Exposed
13	Maritime	13	Enclosed Space	13	Standby
		14	Temp. Controlled Space	14	Operation
20	Temperate		Surface Vehicle		T of O
21	Continental	21	In Open	21	Storage - Boxed
22	Desert	22	Overhead Shelter	22	Storage - Exposed
23	Highland	23	Enclosed Space	23	Standby
24	Maritime	24	Temp. Controlled Space	24	Operation
30	Tropical		Sea Vehicle		
31	Desert	31	In Open		
32	Highland	32	Overhead Shelter		
33	Jungle	33	Enclosed Space		
34	Maritime	34	Temp. Controlled Space		
			Flight Vehicle		
		41	No Press. or Temp. Control		
		42	Pressurized, Unheated		
		43	Unpressurized, Heated		
		44	Pressurized, Heated		

Using above classification, with following order.

Macro-location	Micro-location	Status
1st 2 digits	2nd 2 digits	3rd 2 digits

get a digit groups representing real climatic and geographical environment.

Example: Environment of a spare tire on a jeep in Vietnam would probably be coded as:

33 21 23

33 - Tropical Jungle
21 - In Open on Land Surface Vehicle
23 - T. of O. Standby

Next step - Assign SEF to environment descriptions. These will be assigned on basis of most obvious ones first, keeping the number of SEF assigned to a minimum for this go-round. SEF will be assigned to represent deviations from the standard temperate (Ac) environment of construction of most devices. In the context of the report, they are to represent the differences between the ambient environments Ac and Ad or Ax.

<u>T of O</u> - Table not prepared.
<u>Z of I</u> - Will illustrate in following tables.

LANGUAGE			CODE						
	Real Environment	SEF	Real Environment						SEF
Z of I	Ice Cap, In Open, Boxed	Tl,Zt	11	11	11	11	12		
	" " " " Exposed	Tl,Im,Zt,Pn	"	"	12	04	06	11	12
	" " " " Standby	Tl,Im	"	"	13	04	11		
	" " " " Operation	Tl,Im	"	"	14	04	11		
	" " Roof, Boxed	Tl,Zt	11	12	11	11	12		
	" " " Exposed	Tl,Im,Zt	"	"	12	04	11	12	
	" " " Standby	Tl,Im	"	"	13	04	11		
	" " " Operation	Tl,Im	"	"	14	04	11		
	" " Encl. Space, Boxed	Tl,Zt	11	13	11	11	12		
	" " " " Exposed	Tl,Zt	"	"	12	11	12		
	" " " " Standby	Tl	"	"	13	11			
	" " " " Operation	Tl	"	"	14	11			
	" " Temp. Cont, Boxed	Zt	11	14	11	11			
	" " " " Exposed	Zt	"	"	12	11			
	" " " " Standby	-	"	"	13	-			
	" " " " Operation	-	"	"	14	-			
	" " Surf. Veh, Open Boxed	Tl,Ar,Zt	11	21	11	01	11	12	
	" " " " " Exp.	Tl,Ar,Im,Zt	"	"	12	01	04	11	12
	" " " " " Stdby	Tl,Ar,Im	"	"	13	01	04	11	
	" " " " " Oper.	Tl,Ar,Im	"	"	14	01	04	11	
	" " " " O.H. Shelt B	Tl,Ar,Zt	11	22	11	01	11	12	
	" " " " O.H. Shelt Exp.	Tl,Ar,Im,Zt	"	"	12	01	04	11	12
	" " " " O.H. Shelt Standby	Tl,Ar,Im	"	"	13	01	04	11	
	" " " " O.H. Shelt Operation	Tl,Ar,Im	"	"	14	01	04	11	
	" " " " Encl Bx	Tl,Ar,Zt	11	23	11	01	11	12	
	" " " " " Exp.	Tl,Ar,Zt	"	[illegible]	12	01	11	12	
	" " " " " Stdby	Tl,Ar	"	"	13	01	11		
	" " " " " Oper.	Tl,Ar	"	"	14	01	11		
	" " " " HTD Bx	Ar,Zt,Tc	11	24	11	01	09	12	
	" " " " " Exp.	Ar,Zt,Tc	"	"	12	01	09	12	
	" " " " " Stdby	Ar,Tc	"	"	13	01	09		
	" " " " " Oper	Ar	"	"	14	01	09		

CODE REAL ENVIRONMENT			CODE SEF					
Macro	Micro	Status						
11	31	-	Not Applicable					
10	41	11	01	05	11	12		Tl,Ar,Pc,Zt
"	"	12	01	05	11	12		Tl,Ar,Pc,Zt
"	"	13	01	05	11			Tl,Ar,Pc
"	"	14	01	05	11			Tl,Ar,Pc
10	42	11	01	11	12			Tl,Ar,Zt
"	"	12	01	12	12			Tl,Ar,Zt
"	"	13	01	11				Tl,Zr
"	"	14	01	11				Tl,Ar
10	43	11	01	05	09	12		Tc,Ar,Pc,Zt
"	"	12	01	05	09	12		Tc,Ar,Pc,Zt
"	"	13	01	05	09			Tc,Ar,Pc
"	"	14	01	05	09			Tc,Ar,Pc
10	44	11	01	09	12			Tc,Ar
"	"	12	01	09	12			Tc,Ar
"	"	13	01	09				Tc,Ar
"	"	14	01	09				Tc,Ar
12	11	11	02	11	12			Tl,Cs,Zt
"	"	12	02	04	06	11	12	Tl,Cs,Ph,Zt,Im
"	"	14	02	04	11			Tl,Cs,Im
12	12	11	02	11	12			Tl,Cs,Zt
"	"	12	02	04	11	12		Tl,Cs,Zt,Im
"	"	13	02	04	11			Cs,Im,Tl
"	"	14	02	04	11			Cs,Im,Tl
12	13	11	11	12				Tl,Zt
"	"	12	11	12				Tl,Zt
"	"	13	11					Tl
"	"	14	11					Tl
12	14	11	12					Zt
"	"	12	12					Zt
"	"	13	-					
"	"	14	-					
12	21	11	01	02	11	12		Tl,Ar,Zt,Cs
"	"	12	01	02	04	11	12	Tl,Ar,Zt,Cs,Im
"	"	13	01	02	04	11		Tl,Ar,Im,Cs
"	"	14	01	02	04	11		Tl,Ar,Im,Cs

R. E.		SEF						
Macro	Micro	Status	CODE					
12	22	11	01	02	11	12		Tl,Ar,Zt,Cs
"	"	12	01	02	04	11	12	Tl,Ar,Zt,Cs,Im
"	"	13	01	02	04	11		Tl,Ar,Cs,Im
"	"	14	01	02	04	11		Tl,Ar,Cs,Im
12	23	11	01	02	11	12		Tl,Ar,Zt,Cs
"	"	12	01	02	11	12		Tl,Ar,Zt,Cs
"	"	13	01	02	11			Tl,Ar,Cs
"	"	14	01	02	11			Tl,Ar,Cs
12	24	11	01	02	09	12		Ar,Zt,Cs,Tc
"	"	12	01	02	09	12		Ar,Zt,Cs,Tc
"	"	13	01	02	09			Ar,Cs,Tc
"	"	14	01	02	09			Ar,Cs,Tc
12	31	11	Not Applicable					
13	11	11	02	11	12			Tl,Zt,Cs
"	"	12	02	04	06	11	12	Tl,Zt,Cs,Im,Ph
"	"	13	02	04	11			Tl,Cs,Im
"	"	14	02	04	11			Tl,Cs,Im
13	12	11	02	11	12			Tl,Zt,Cs
"	"	12	02	04	11	12		Tl,Zt,Cs,Im
"	"	13	02	04	11			Tl,Cs,Im
"	"	14	02	04	11			Tl,Cs,Im
13	13	11	02	11	[illegible]			Tl,Zt,Cs
"	"	12	02	11	12			Tl,Zt,Cs
"	"	13	02	11				Tl,Cs
"	"	14	02	11				Tl,Cs
13	14	11	02	12				Cs,Zt
"	"	12	02	12				Cs,Zt
"	"	13	02					Cs
"	"	14	02					Cs
13	21	11	01	02	11	12		Tl,Zt,Ar,Cs
"	"	12	01	02	04	11	12	Tl,Zt,Ar,Cs,Im
"	"	13	01	02	04	11		Tl,Ar,Cs,Im
"	"	14	01	02	04	11		Tl,Ar,Cs,Im
13	22	11	01	02	11	12		Tl,Zt,Ar,Cs
"	"	12	01	02	04	11	12	Tl,Zt,Ar,Cs,Im
"	"	13	01	02	04	11		Tl,Ar,Cs,Im
"	"	14	01	02	04	11		Tl,Ar,Cs,Im

R. E.		SEF						
Macro	Micro	Status	CODE					
12	22	11	01	02	11	12		Tl,Ar,Zt,Cs
"	"	12	01	02	04	11	12	Tl,Ar,Zt,Cs,Im
"	"	13	01	02	04	11		Tl,Ar,Cs,Im
"	"	14	01	02	04	11		Tl,Ar,Cs,Im
12	23	11	01	02	11	12		Tl,Ar,Zt,Cs
"	"	12	01	02	11	12		Tl,Ar,Zt,Cs
"	"	13	01	02	11			Tl,Ar,Cs
"	"	14	01	02	11			Tl,Ar,Cs
12	24	11	01	02	09	12		Ar,Zt,Cs,Tc
"	"	12	01	02	09	12		Ar,Zt,Cs,Tc
"	"	13	01	02	09			Ar,Cs,Tc
"	"	14	01	02	09			Ar,Cs,Tc
12	31	11	Not Applicable					
13	11	11	02	11	12			Tl,Zt,Cs
"	"	12	02	04	06	11	12	Tl,Zt,Cs,Im,Ph
"	"	13	02	04	11			Tl,Cs,Im
"	"	14	02	04	11			Tl,Cs,Im
13	12	11	02	11	12			Tl,Zt,Cs
"	"	12	02	04	11	12		Tl,Zt,Cs,Im
"	"	13	02	04	11			Tl,Cs,Im
"	"	14	02	04	11			Tl,Cs,Im
13	13	11	02	11	[illegible]			Tl,Zt,Cs
"	"	12	02	11	12			Tl,Zt,Cs
"	"	13	02	11				Tl,Cs
"	"	14	02	11				Tl,Cs
13	14	11	02	12				Cs,Zt
"	"	12	02	12				Cs,Zt
"	"	13	02					Cs
"	"	14	02					Cs
13	21	11	01	02	11	12		Tl,Zt,Ar,Cs
"	"	12	01	02	04	11	12	Tl,Zt,Ar,Cs,Im
"	"	13	01	02	04	11		Tl,Ar,Cs,Im
"	"	14	01	02	04	11		Tl,Ar,Cs,Im
13	22	11	01	02	11	12		Tl,Zt,Ar,Cs
"	"	12	01	02	04	11	12	Tl,Zt,Ar,Cs,Im
"	"	13	01	02	04	11		Tl,Ar,Cs,Im
"	"	14	01	02	04	11		Tl,Ar,Cs,Im

R. E.		SEF						
Macro	Micro	Status	CODE					
13	23	11	01	02	11	12		Tl,Cs,Zt,Ar
"	"	12	01	02	11	12		Tl,Cs,Zt,Ar
"	"	13	01	02	11			Tl,Cs,Ar
"	"	14	01	02	11			Tl,Cs,Ar
13	24	11	01	02	09	12		Cs,Ar,Zt,Tc
"	"	12	01	02	09	12		Cs,Ar,Zt,Tc
"	"	13	01	02	09			Ar,Cs,Tc
"	"	14	01	02	09			Ar,Cs,Tc
13	31	11	01	02	11	12		Same as
"	"	12	01	02	04	11	12	13211X
"	"	13	01	02	04	11		
"	"	14	01	02	04	11		
13	32	11	01	02	11	12		Same as
"	"	12	01	02	04	11	12	13221X
"	"	13	01	02	04	11		
"	"	14	01	02	04	11		
13	33	11	01	02	11	12		Same as
"	"	12	01	02	11	12		13231X
"	"	13	01	02	11			
"	"	14	01	02	11			
13	34	11	01	02	09	12		Same as
"	"	12	01	02	09	12		13241X
"	"	13	01	02	09			
"	"	14	01	02	09			
13	4X	1X	Not Applicable					
20	41	11	01	05	07	09	11	Tl,Tc,Ar,Pc,Pl
"	"	12	01	05	07	09	11	Tl,Tc,Ar,Pc,Pl
"	"	13	01	05	07	09	11	Tl,Tc,Ar,Pc,Pl
"	"	14	01	05	07	09	11	Tl,Tc,Ar,Pc,Pl
20	42	11	01	09	11			Ar,Tl,Tc
"	"	12	01	09	11			Ar,Tl,Tc
"	"	13	01	09	11			Ar,Tl,Tc
"	"	14	01	09	11			Ar,Tl,Tc
20	43	11	01	05	07			Ar,Pl,Pc
"	"	12	01	05	07			Ar,Pl,Pc
"	"	13	01	05	07			Ar,Pl,Pc
"	"	14	01	05	07			Ar,Pl,Pc

R. E.			SEF				
Macro	Micro	Status	CODE				
20	44	11	01				Ar
"	"	12	01				Ar
"	"	13	01				Ar
"	"	14	01				Ar
21	1X	1X	-				None (Def)
21	21	11	01	03			Ar,Fd
"	"	12	01	03			Ar,Fd
"	"	13	01				Ar
"	"	14	01				Ar
21	22	11	01	03	12		Ar,Fd,Zt
"	"	12	01	04	12		Ar,Im,Zt
"	"	13	01	04			Ar,Im
"	"	14	01	04			Ar,Im
21	23	11	01	12			Ar,Zt
"	"	12	01	12			Ar,Zt
"	"	13	01				Ar
"	"	14	01				Ar
21	24	11	01				Ar
"	"	12	01				Ar
"	"	13	01				Ar
"	"	14	01				Ar
21	3X	1X	Not Applicable				
21	4X	1X	Not Applicable				
22	11	11	03	09	10		Th,Tc,Fd
"	"	12	03	04	08	10	Th,Ri,Im,Fd
"	"	13	03	04	08	10	Th,Ri,Im,Fd
"	"	14	03	04	08	10	Th,Ri,Im,Fd
22	12	11	10				Th
"	"	12	04	10			Th,Im
"	"	13	04	10			Th,Im
"	"	14	04	10			Th,Im
22	13	11	10				Th
"	"	12	10				Th
"	"	13	10				Th
"	"	14	10				Th
22	14	11	-				-
"	"	12	-				-
"	"	13	-				-
"	"	14	-				-

	R. E.		SEF					
Macro	Micro	Status	CODE					
22	21	11	01	09	10			Th,Tc,Ar
"	"	12	01	04	08	10		Ar,Im,Ri,Th
"	"	13	01	04	08	10		Ar,Im,Ri,Th
"	"	14	01	04	08	10		Ar,Im,Ri,Th
22	22	11	01	09	10			Th,Tc,Ar
"	"	12	01	04	10			Th,Im,Ar
"	"	13	01	04	10			Th,Im,Ar
"	"	14	01	04	10			Th,Im,Ar
22	23	11	01	10				Th,Ar
"	"	12	01	10				Th,Ar
"	"	13	01	10				Th,Ar
"	"	14	01	10				Th,Ar
22	24	11	01					Ar
"	"	12	01					"
"	"	13	01					"
"	"	14	01					"
22	3X	1X	Not Applicable					
22	4X	1X	Not Applicable					
23	11	11	03	10	11			Th,Tl,Fd
"	"	12	03	04	08	10	11	Th,Tl,Im,Ri,Fd
"	"	13	03	04	08	10	11	Th,Tl,Im,Ri,Fd
"	"	14	03	04	08	10	11	Th,Tl,Im,Ri,Fd
23	12	11	10	11				Th,Tl
"	"	12	04	11				Tl,Im
"	"	13	04	11				Tl,Im
"	"	14	04	11				Tl,Im
23	13	11	11					Tl
"	"	12	11					Tl
"	"	13	11					Tl
"	"	14	11					Tl
23	14	11	-					-
"	"	12	-					-
"	"	13	-					-
"	"	14	-					-
23	21	11	01	10	11			Th,Tl,Ar
"	"	12	01	04	08	11		Tl,Ar,Ri,Im
"	"	13	01	04	08	11		Tl,Ar,Ri,Im
"	"	14	01	04	08	11		Tl,Ar,Ri,Im

R. E.					SEF	
Macro	Micro	Status			CODE	
23	22	11	01	11		Te,Ar
"	"	12	01	04	11	" ,Im
"	"	13	01	04	11	" "
"	"	14	01	04	11	" "
23	23	11	01	11		Te,Ar
"	"	12	01	11		"
"	"	13	01	11		"
"	"	14	01	11		"
23	24	11	01			Ar
"	"	12	01			"
"	"	13	01			"
"	"	14	01			"
24	11	11	02			Cs
"	"	12	02	08		Cs,Ri
"	"	13	02	08		Cs,Ri
"	"	14	02	08		Cs,Ri
24	12	11	02			Cs
"	"	12	02			"
"	"	13	02			"
"	"	14	02			"
24	13	11	02			Cs
"	"	12	02			"
"	"	13	02			"
"	"	14	02			"
24	14	11	02			Cs
"	"	12	02			"
"	"	13	02			"
"	"	14	02			"
24	21	11	01	02		Ar,Cs
"	"	12	01	02	08	" " , Ri
"	"	13	01	02	08	" " "
"	"	14	01	02	08	" " "
24	22	11	01	02		Ar,Cs
"	"	12	01	02		"
"	"	13	01	02		"
"	"	14	01	02		"
24	23	11	01	02		Ar,Cs
"	"	12	01	02		
"	"	13	01	02		
"	"	14	01	02		

R. E.		SEF						
Macro	Micro	Status	CODE					
24	24	11	01	02				Cs,Ar
"	"	12	01	02				"
"	"	13	01	02				"
"	"	14	01	02				"
24	31	11	01	02				Cs,Ar
"	"	12	01	02	08			" & Ri
"	"	13	01	02	08			" "
"	"	14	01	02	08			" "
24	32	11	01	02				Cs,Ar
"	"	12	01	02				"
"	"	13	01	02				"
"	"	14	01	02				"
24	33	11	01	02				Cs,Ar
"	"	12	01	02				"
"	"	13	01	02				"
"	"	14	01	02				"
24	34	11	01	02				Cs,Ar
"	"	12	01	02				"
"	"	13	01	02				"
"	"	14	01	02				"
24	4X	1X	Not Applicable					
30	41	11	01	05	07	09	11	Tl,Ar,Pc,Tc,Pl
"	"	12	01	05	07	09	11	" " " "
"	"	13	01	05	07	09	11	" " " "
"	"	14	01	05	07	09	11	" " " "
30	42	11	01	09	11			Tl,Ar,Tc
"	"	12	01	09	11			" " "
"	"	13	01	09	11			" " "
"	"	14	01	09	11			" " "
30	43	11	01	05	07			Ar,Pc,Pl
"	"	12	01	05	07			" " "
"	"	13	01	05	07			" " "
"	"	14	01	05	07			" " "
30	44	11	01					Ar
"	"	12	01					"
"	"	13	01					"
"	"	14	01					"

R. E.		SEF						
Macro	Micro	Status	CODE					
31	11	11	03	10				Th,Fd
"	"	12	03	04	08	10		Th,Ri,Im,Fd
"	"	13	03	04	08	10		" " " ,Fd
"	"	14	03	04	08	10		" " " ,Fd
31	12	11	10					Th
"	"	12	04	10				Th,Im
"	"	13	04	10				" "
"	"	14	04	10				" "
31	13	11	10					Th
"	"	12	10					Th
"	"	13	10					Th
"	"	14	10					Th
31	14	11	-					-
"	"	12	-					-
"	"	13	-					-
"	"	14	-					-
31	21	11	01	10				Th,Ar
"	"	12	01	04	08	10		Th,Ar,Ri,Im
"	"	13	01	04	08	10		" " " "
"	"	14	01	04	08	10		" " " "
31	22	11	01	10				Th,Ar
"	"	12	01	04	10			Th,Ar,Im
"	"	13	01	04	10			" " "
"	"	14	01	04	10			" " "
31	23	11	01	10				Th,Ar
"	"	12	01	10				"
"	"	13	01	10				"
"	"	14	01	10				"
31	24	11	01					Ar
"	"	12	01					"
"	"	13	01					"
"	"	14	01					"
31	3X	1X	Not Applicable					
31	4X	1X	Not Applicable					
32	11	11	03	09	10			Th,Tc,Fd
"	"	12	03	04	08	09	10	Ri,Th,Tc,Fd,Im
"	"	13	03	04	08	09	10	Ri,Th,Tc,Fd,Im
"	"	14	03	04	08	09	10	Ri,Th,Tc,Fd,Im

R. E.			SEF					
Macro	Micro	Status	CODE					
32	12	11	03	09	10			Th,Tc,Fd
"	"	12	03	04	09	10		Th,Tc,Fd,Im
"	"	13	03	04	09	10		Th,Tc,Fd,Im
"	"	14	03	04	09	10		Th,Tc,Fd,Im
32	13	11	09	10				Th,Tc
"	"	12	09	10				
"	"	13	09	10				
"	"	14	09	10				
32	14	11	-					-
"	"	12	-					-
"	"	13	-					-
"	"	14	-					-
32	21	11	01	09	10			Th,Tc,Ar
"	"	12	01	04	08	09	10	Th,Tc,Ar,Ri,Im
"	"	13	01	04	08	09	10	" " " " "
"	"	14	01	04	08	09	10	" " " " "
32	22	11	01	10				Th,Ar
"	"	12	01	04	10			Th,Ar,Im
"	"	13	01	04	10			" " "
"	"	14	01	04	10			" " "
32	23	11	01	10				Th,Ar
"	"	12	01	10				"
"	"	13	01	10				"
"	"	14	01	10				"
32	24	11	01					Ar
"	"	12	01					"
"	"	13	01					"
"	"	14	01					"
32	3X	1X	Not Applicable					
32	4X	1X	Not Applicable					
33	11	11	02	03	10			Th,Fd,Cs
"	"	12	02	03	04	08	10	" " & Im & Ri
"	"	13	02	03	04	08	10	" " " "
"	"	14	02	03	04	08	10	" " " "
33	12	11	02	03	10			Th,Cs,Fd
"	"	12	02	03	04	10		" " & Im,Fd
"	"	13	02	03	04	10		" " "
"	"	14	02	03	04	10		" " "

R. E.			SEF					
Macro	Micro	Status	CODE					
33	13	11	02	10				Th,Cs
"	"	12	02	10				" "
"	"	13	02	10				" "
"	"	14	02	10				" "
33	14	11	02					Cs
"	"	12	02					"
"	"	13	02					"
"	"	14	02					"
33	21	11	01	02	10			Th,Cs,Ar,
"	"	12	01	02	04	08	10	Th,Cs,Ar,Im,Ri
"	"	13	01	02	04	08	10	" " " " "
"	"	14	01	02	04	08	10	" " " " "
33	22	11	01	02	10			Th,Cs,Ar
"	"	12	01	02	04	10		" " " ,Im
"	"	13	01	02	04	10		" " " "
"	"	14	01	02	04	10		" " " "
33	23	11	01	02	10			Th,Cs,Ar
"	"	12	01	02	10			" " "
"	"	13	01	02	10			" " "
"	"	14	01	02	10			" " "
33	24	11	01	02				Cs,Ar
"	"	12	01	02				" "
"	"	13	01	02				" "
"	"	14	01	02				" "
33	3X	1X	Not Applicable					
33	4X	1X	Not Applicable					
34	11	11	02	03	10			Th,Cs,Fd,Im
"	"	12	02	03	04	08	10	Th,Cs,Ri,Im,Fd
"	"	13	02	03	04	08	10	" " " " "
"	"	14	02	03	04	08	10	" " " " "
34	12	11	02	03	10			Th,Cs,Fd
"	"	12	02	03	04	10		Th,Cs,Fd,Im
"	"	13	02	03	04	10		Th,Cs,Fd,Im
"	"	14	02	03	04	10		Th,Cs,Fd,Im
34	13	11	02	10				Th,Cs
"	"	12	02	10				Th,Cs
"	"	13	02	10				Th,Cs
"	"	14	02	10				Th,Cs

R. E.			SEF					
Macro	Micro	Status	CODE					
34	14	11	02					Cs
"	"	12	02					"
"	"	13	02					"
"	"	14	02					"
34	21	11	01	02	10			Ar, Th, Cs
"	"	12	01	02	04	08	10	" " " ,Ri, Im
"	"	13	01	02	04	08	10	" " " "
"	"	14	01	02	04	08	10	" " " "
34	22	11	01	02	10			Ar, Th, Cs
"	"	12	01	02	04	10		" " " ,Im
"	"	13	01	02	04	10		" " " "
"	"	14	01	02	04	10		" " " "
34	23	11	01	02	10			Ar, Th, Cs
"	"	12	01	02	10			"
"	"	13	01	02	10			"
"	"	14	01	02	10			"
34	24	11	01	02				Ar, Cs
"	"	12	01	02				
"	"	13	01	02				
"	"	14	01	02				
34	31	11	01	02	10			Ar, Th, Cs
"	"	12	01	02	04	08	10	" " " ,Ri, Im
"	"	13	01	02	04	08	10	" " " " "
"	"	14	01	02	04	08	10	" " " " "
34	32	11	01	02	10			Ar, Th, Cs
"	"	12	01	02	04	10		" & Im
"	"	13	01	02	04	10		" "
"	"	14	01	02	04	10		" "
34	33	11	01	02	10			Ar, Th, Cs
"	"	12	01	02	10			"
"	"	13	01	02	10			"
"	"	14	01	02	10			"
34	34	11	01	02				Ar, Cs
"	"	12	01	02				
"	"	13	01	02				
"	"	14	01	02				
34	4X	1X	Not Applicable					

APPENDIX 4

Catalog B

Contains entries relating 2-SEF, 1-SUP, and their effects. Each entry is an 8-digit decimal number, according to the following code:

1st 2 digits	-	1st SEF)
2nd 2 digits	-	2nd SEF)
3rd 2 digits	-	SUP)
4th 2 digits	-	Effects)

Example:

Th and Im have ID effect on STR state.

Coded - 04 10 07 03

Im Th STR ID

Note: Lowest numbered SEF must be placed first, as below - not 10040703, which is not included in the table. (Arrangement of symbols is alphabetic).

SEF	CODE
Ar	01
Cs	02
Fd	03
Im	04
Pc	05
Ph	06
Pl	07
Ri	08
Ic	09
Th	10
Tl	11
Zt	12

SUP	CODE
CHEM	01
CLN	02
ELAS	03
EM	04
RHEO	05
STN	06
STR	07
THER	08

EFFECT	CODE
O	01
I^2	02
ID	03
D^2	04

SEF-SUP-EFF TO DIGITAL REPRESENTATION

SEF_1	SEF_2	SUP	EFF	DIGITAL REPRESENTATION			
Ar	Ar	CHEM	0	01	01	01	01
"	"	CLN	0	01	01	02	01
"	"	ELAS	0	01	01	03	01
"	"	EM	0	01	01	04	01
"	"	RHEO	0	01	01	05	01
"	"	STN	0	01	01	06	01
"	"	STR	0	01	01	07	01
"	"	THER	0	01	01	08	01
Ar	Cs	CHEM	0	01	02	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	0	"	"	05	01
"	"	STN	I^2	"	"	06	02
"	"	STR	0	"	"	07	01
"	"	THER	I^2	"	"	08	02
Ar	Fd	CHEM	0	01	03	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	0	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	0	"	"	07	01
"	"	THER	I^2	"	"	08	02
Ar	Im	CHEM	0	01	04	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	0	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Ar	Pc	CHEM	0	01	05	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	0	"	"	05	01
"	"	STN	D^2	"	"	06	04
"	"	STR	0	"	"	07	01
"	"	THER	I^2	"	"	08	02

SEF$_1$	SEF$_2$	SUP	EFF	DIGITAL REPRESENTATION			
Ar	Ph	CHEM	O	01	06	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	O	"	"	05	01
"	"	STN	D^2	"	"	06	04
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Ar	Pl	CHEM	O	01	07	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	O	"	"	05	01
"	"	STN	D^2	"	"	06	04
"	"	STR	T^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Ar	Ri	CHEM	O	01	08	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	O	"	"	05	01
"	"	STN	O	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Ar	Tc	CHEM	O	01	09	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	D^2	"	"	06	04
"	"	STR	I^2	"	"	07	02
"	"	THER	ID	"	"	08	03
Ar	Th	CHEM	O	01	10	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03

SEF_1	SEF_2	SUP	EFF	DIGITAL REPRESENTATION			
Ar	[illegible]	CHEM	O	01	11	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03
Ar	Zt	CHEM	O	01	12	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	I^2	"	"	07	02
"	"	THER	O	"	"	08	01
Cs	Cs	CHEM	O	02	02	01	01
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	O	"	"	06	01
"	"	STR	O	"	"	07	01
"	"	THER	O	"	"	08	01
Cs	Pd	CHEM	ID	02	03	01	03
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	O	"	"	05	01
"	"	STN	O	"	"	06	01
"	"	STR	O	"	"	07	01
"	"	THER	I^2	"	"	08	02
Cs	Im	CHEM	O	02	04	01	01
"	"	CLN	ID	"	"	02	03
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	I^2	"	"	05	02
"	"	STN	O	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02

SEF$_1$	SEF$_2$	SUP	EFF	DIGITAL REPRESENTATION			
Ar	Tm	CHEM	O	01	11	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03
Ar	Zt	CHEM	O	01	12	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	I^2	"	"	07	02
"	"	THER	O	"	"	08	01
Cs	Cs	CHEM	O	02	02	01	01
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	O	"	"	06	01
"	"	STR	O	"	"	07	01
"	"	THER	O	"	"	08	01
Cs	Pd	CHEM	ID	02	03	01	03
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	O	"	"	05	01
"	"	STN	O	"	"	06	01
"	"	STR	O	"	"	07	01
"	"	THER	I^2	"	"	08	02
Cs	Im	CHEM	O	02	04	01	01
"	"	CLN	ID	"	"	02	03
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	I^2	"	"	05	02
"	"	STN	O	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02

SEF_1	SEF_2	SUP	EFF	DIGITAL REPRESENTATION			
Cs	Pc	CHEM	0	02	05	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	0	"	"	05	01
"	"	STN	0	"	"	06	01
"	"	STR	0	"	"	07	01
"	"	THER	I^2	"	"	08	02
Cs	Ph	CHEM	ID	02	06	01	03
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	0	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	I^2	"	"	05	02
"	"	STN	0	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Cs	Pl	CHEM	ID	02	07	01	03
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	0	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	0	"	"	05	01
"	"	STN	0	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Cs	Ri	CHEM	ID	02	08	01	03
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	I^2	"	"	05	02
"	"	STN	0	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Cs	Tc	CHEM	ID	02	09	01	03
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	0	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	ID	"	"	08	03

SEF_1	SEF_2	SUP	EFF	DIGITAL REPRESENTATION			
Cs	Th	CHEM	ID	02	10	01	03
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	ID	"	"	05	03
"	"	STN	O	"	"	06	01
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03
Cs	Tl	CHEM	ID	02	11	01	03
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	ID	"	"	05	03
"	"	STN	O	"	"	06	01
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03
Cs	Zt	CHEM	ID	02	12	01	03
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	I^2	"	"	05	02
"	"	STN	O	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	O	"	"	08	01
Fd	Fd	CHEM	I^2	03	03	01	02
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	D^2	"	"	04	04
"	"	RHEO	O	"	"	05	01
"	"	STN	I^2	"	"	06	02
"	"	STR	O	"	"	07	01
"	"	THER	I^2	"	"	08	02
Fd	Im	CHEM	O	03	04	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	O	"	"	05	01
"	"	STN	I^2	"	"	06	02
"	"	STR	O	"	"	07	01
"	"	THER	I^2	"	"	08	02

SEF_1	SEF_2	SUP	EFF	DIGITAL REPRESENTATION			
Fd	Pc	CHEM	O	03	05	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	O	"	"	07	01
"	"	THER	I^2	"	"	08	02
Fd	Ph	CHEM	I^2	03	06	01	02
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	O	"	"	07	01
"	"	THER	I^2	"	"	08	02
Fd	Pl	CHEM	I^2	03	07	01	02
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	O	"	"	07	01
"	"	THER	I^2	"	"	08	02
Fd	Ri	CHEM	I^2	03	08	01	02
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	D^2	"	"	04	04
"	"	RHEO	O	"	"	05	01
"	"	STN	O	"	"	06	01
"	"	STR	O	"	"	07	01
"	"	THER	I^2	"	"	08	02
Fd	Tc	CHEM	I^2	03	09	01	02
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	O	"	"	07	01
"	"	THER	ID	"	"	08	03

SEF_1	SEF_2	SUP	EFF	DIGITAL REPRESENTATION			
Fd	Th	CHEM	I^2	03	10	01	02
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	O	"	"	05	01
"	"	STN	I^2	"	"	06	02
"	"	STR	O	"	"	07	01
"	"	THER	ID	"	"	08	03
Fd	Tl	CHEM	I^2	03	11	01	02
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	I^2	"	"	06	02
"	"	STR	O	"	"	07	01
"	"	THER	ID	"	"	08	03
Fd	Zt	CHEM	I^2	03	12	01	02
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	I^2	"	"	06	02
"	"	STR	O	"	"	07	01
"	"	THER	O	"	"	08	01
Im	Im	CHEM	O	04	04	01	01
"	"	CLN	D^2	"	"	02	04
"	"	ELAS	I^2	"	"	03	02
"	"	EM	I^2	"	"	04	02
"	"	RHEO	I^2	"	"	05	02
"	"	STN	I^2	"	"	06	02
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Im	Pc	CHEM	O	04	05	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	O	"	"	07	01
"	"	THER	I^2	"	"	08	02

SEF$_1$	SEF$_2$	SUP	EFF	DIGITAL REPRESENTATION			
Im	Ph	CHEM	O	04	06	01	01
"	"	CLN	ID	"	"	02	03
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	I^2	"	"	05	02
"	"	STN	ID	"	"	06	03
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Im	Pd	CHEM	O	04	07	01	01
"	"	CLN	ID	"	"	02	03
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Im	Ri	CHEM	O	04	08	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	I^2	"	"	03	02
"	"	EM	ID	"	"	04	03
"	"	RHEO	I^2	"	"	05	02
"	"	STN	O	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Im	Tc	CHEM	O	04	09	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	I^2	"	"	07	02
"	"	THER	ID	"	"	08	03
Im	Th	CHEM	O	04	10	01	01
"	"	CLN	ID	"	"	02	03
"	"	ELAS	ID	"	"	03	03
"	"	EM	I^2	"	"	04	02
"	"	RHEO	ID	"	"	05	03
"	"	STN	I^2	"	"	06	02
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03

SEF$_1$	SEF$_2$	SUP	EFF	DIGITAL REPRESENTATION			
Im	Tl	CHEM	O	04	11	01	01
"	"	CLN	ID	"	"	02	03
"	"	ELAS	ID	"	"	03	03
"	"	EM	O	"	"	04	01
"	"	RHEO	ID	"	"	05	03
"	"	STN	I^2	"	"	06	02
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03
Im	Zt	CHEM	O	04	12	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	I^2	"	"	03	02
"	"	EM	O	"	"	04	01
"	"	RHEO	I^2	"	"	05	02
"	"	STN	I^2	"	"	06	02
"	"	STR	I^2	"	"	07	02
"	"	THER	O	"	"	08	01
Pc	Pc	CHEM	O	05	05	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	O	"	"	06	01
"	"	STR	O	"	"	07	01
"	"	THER	O	"	"	08	01
Pc	Ph	CHEM	O	05	06	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	O	"	"	05	01
"	"	STN	D^2	"	"	06	04
"	"	STR	O	"	"	07	01
"	"	THER	I^2	"	"	08	02
Pc	Pl	CHEM	O	05	07	01	01
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	O	"	"	05	01
"	"	STN	D^2	"	"	06	04
"	"	STR	O	"	"	07	01
"	"	THER	I^2	"	"	08	02

SEF_1	SEF_2	SUP	EFF	DIGITAL REPRESENTATION			
Pc	Ri	CHEM	0	05	08	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	0	"	"	05	01
"	"	STN	0	"	"	06	01
"	"	STR	0	"	"	07	01
"	"	THER	I^2	"	"	08	02
Pc	Tc	CHEM	0	05	09	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	D^2	"	"	06	04
"	"	STR	0	"	"	07	01
"	"	THER	ID	"	"	08	03
Pc	Th	CHEM	0	05	10	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	0	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	0	"	"	07	01
"	"	THER	ID	"	"	08	03
Pc	Tl	CHEM	0	05	11	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	0	"	"	07	01
"	"	THER	ID	"	"	08	03
Pc	Zt	CHEM	0	05	12	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	0	"	"	07	01
"	"	THER	0	"	"	08	01

SEF_1	SEF_2	SUP	EFF	DIGITAL REPRESENTATION			
Ph	Ph	CHEM	I^2	06	06	01	02
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	0	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	I^2	"	"	05	02
"	"	STN	D^2	"	"	06	04
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Ph	Pl	CHEM	0	06	07	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	0	"	"	06	01
"	"	STR	0	"	"	07	01
"	"	THER	0	"	"	08	01
Ph	Ri	CHEM	I^2	06	08	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	I^2	"	"	05	02
"	"	STN	0	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Ph	Tc	CHEM	I^2	06	09	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	D^2	"	"	06	04
"	"	STR	I^2	"	"	07	02
"	"	THER	ID	"	"	08	03
Ph	Th	CHEM	I^2	06	10	01	02
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	0	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	ID	"	"	05	03
"	"	STN	ID	"	"	06	03
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03

SEF$_1$	SEF$_2$	SUP	EFF	DIGITAL REPRESENTATION			
Ph	Tl	CHEM	I^2	06	11	01	02
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	ID	"	"	05	03
"	"	STN	ID	"	"	06	03
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03
Ph	Zt	CHEM	I^2	06	12	01	02
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	I^2	"	"	05	02
"	"	STN	ID	"	"	06	03
"	"	STR	I^2	"	"	07	02
"	"	THER	O	"	"	08	01
Pl	Pl	CHEM	I^2	07	07	01	02
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	O	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	O	"	"	05	01
"	"	STN	D^2	"	"	06	04
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Pl	Ri	CHEM	I^2	07	08	01	02
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	ID	"	"	04	03
"	"	RHEO	O	"	"	05	01
"	"	STN	O	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Pl	Tc	CHEM	I^2	07	09	01	02
"	"	CLN	O	"	"	02	01
"	"	ELAS	O	"	"	03	01
"	"	EM	O	"	"	04	01
"	"	RHEO	O	"	"	05	01
"	"	STN	D^2	"	"	06	04
"	"	STR	I^2	"	"	07	02
"	"	THER	ID	"	"	08	03

SEF_1	SEF_2	SUP	EFF	DIGITAL REPRESENTATION			
Pl	Th	CHEM	I^2	07	10	01	02
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	0	"	"	03	01
"	"	EM	I^2	"	"	04	02
"	"	RHEO	0	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03
Pl	Tl	CHEM	I^2	07	11	01	02
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03
Pl	Zt	CHEM	I^2	07	12	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	I^2	"	"	07	02
"	"	THER	0	"	"	08	01
Ri	Ri	CHEM	I^2	08	08	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	I^2	"	"	03	02
"	"	EM	D^2	"	"	04	04
"	"	RHEO	I^2	"	"	05	02
"	"	STN	0	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	I^2	"	"	08	02
Ri	Tc	CHEM	I^2	08	09	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	I^2	"	"	06	02
"	"	STR	0	"	"	07	01
"	"	THER	ID	"	"	08	03

SEF_1	SEF_2	SUP	EFF	DIGITAL	REPRESENTATION		
Ri	Th	CHEM	I^2	08	10	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	ID	"	"	03	03
"	"	EM	ID	"	"	04	03
"	"	RHEO	ID	"	"	05	03
"	"	STN	0	"	"	06	01
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03
Ri	Tl	CHEM	I^2	08	11	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	ID	"	"	03	03
"	"	EM	0	"	"	04	01
"	"	RHEO	ID	"	"	05	03
"	"	STN	0	"	"	06	01
"	"	STR	ID	"	"	07	03
"	"	THER	ID	"	"	08	03
Ri	Zt	CHEM	I^2	08	12	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	I^2	"	"	03	02
"	"	EM	0	"	"	04	01
"	"	RHEO	I^2	"	"	05	02
"	"	STN	0	"	"	06	01
"	"	STR	I^2	"	"	07	02
"	"	THER	0	"	"	08	01
Tc	Tc	CHEM	0	09	09	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	0	"	"	06	01
"	"	STR	0	"	"	07	01
"	"	THER	0	"	"	08	01
Tc	Th	CHEM	I^2	09	10	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	ID	"	"	07	03
"	"	THER	D^2	"	"	08	04

SEF_1	SEF_2	SUP	EFF	DIGITAL REPRESENTATION			
Tc	Tl	CHEM	I^2	09	11	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	ID	"	"	07	03
"	"	THER	D^2	"	"	08	04
Tc	Zt	CHEM	I^2	09	12	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	ID	"	"	06	03
"	"	STR	I^2	"	"	07	02
"	"	THER	0	"	"	08	01
Th	Th	CHEM	I^2	10	10	01	02
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	D^2	"	"	03	04
"	"	EM	I^2	"	"	04	02
"	"	RHEO	D^2	"	"	05	04
"	"	STN	I^2	"	"	06	02
"	"	STR	D^2	"	"	07	04
"	"	THER	D^2	"	"	08	04
Th	Tl	CHEM	0	10	11	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	0	"	"	06	01
"	"	STR	0	"	"	07	01
"	"	THER	0	"	"	08	01
Th	Zt	CHEM	I^2	10	12	01,	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	ID	"	"	03	03
"	"	EM	0	"	"	04	01
"	"	RHEO	ID	"	"	05	03
"	"	STN	I^2	"	"	06	02
"	"	STR	ID	"	"	07	03
"	"	THER	0	"	"	08	01

SEF_1	SEF_2	SUP	EFF	DIGITAL	REPRESENTATION		
T1	T1	CHEM	I^2	11	11	01	02
"	"	CLN	I^2	"	"	02	02
"	"	ELAS	D^2	"	"	03	04
"	"	EM	0	"	"	04	01
"	"	RHEO	D^2	"	"	05	04
"	"	STN	I^2	"	"	06	02
"	"	STR	D^2	"	"	07	04
"	"	THER	D^2	"	"	08	04
T1	Zt	CHEM	I^2	11	12	01	02
"	"	CLN	0	"	"	02	01
"	"	ELAS	ID	"	"	03	03
"	"	EM	0	"	"	04	01
"	"	RHEO	ID	"	"	05	03
"	"	STN	I^2	"	"	06	02
"	"	STR	ID	"	"	07	03
"	"	THER	0	"	"	08	01
Zt	Zt	CHEM	0	12	12	01	01
"	"	CLN	0	"	"	02	01
"	"	ELAS	0	"	"	03	01
"	"	EM	0	"	"	04	01
"	"	RHEO	0	"	"	05	01
"	"	STN	0	"	"	06	01
"	"	STR	0	"	"	07	01
"	"	THER	0	"	"	08	01

APPENDIX 5

VIBRATION AND LOW TEMPERATURE TEST #2

Synchro Type 23TX6

23 Oct 1962

Double Amplitude	0.141 Inches
Variable Frequency	5-60-5 cps
Scanning Time	1 Minute
Direction of Vibration	Vertical
Time Duration	6 Hours
Temperature (Air)	-40°F

Time	Current Drawn Synchro #2	Current Drawn Synchro #4	Synchro Temperature °F #2	Synchro Temperature °F #4	Air Temp °F
*1000	.23 Amps	.26 Amps	90°F	91°F	69°F
1010	.23	.26	90°F	91°	60°F
1015	.22	.255	76°	71°	20°F
1020	.22	.25	46°	34°	-25°F
1025	.22	.25	25°	18°	-39°F
1030	.22	.26	11°	4°	-46°F
1035	.22	.26	5°	-3°	-49°F
1040	.22	.26	0°	-1°	-36°F
1045	.22	.26	-3°	-2°	-34°F
1055	.22-.29	.26	-2°	-3°	-38°F
1105	.23	.26	-3°	-3°	-36°F
1200	.23	.265	-9°	-8°	-36°F
1300	.23	.26	-10°	-9°	-40°F
1400	.23	.26	-10°	-9°	-41°F
1500	.23	.26	-7°	-6°	-36°F
1610	.23	.26	-13°	-13°	-36°F
24 Oct 1962					
**0915	.23	.26	84°F	86°F	

* Before Test
** After Test

APPENDIX 6

ALTITUDE AND LOW TEMPERATURE TEST

Synchro Type 23TX6

17 Aug 1962

Altitude 10,000 Ft.
Temperature -65°F
Time Duration 8 Hours

Time	Current Drawn - MA #1	#2	#3	Synchro Temperature °F #1	#2	#3
815	60 ma	76 ma	75 ma	54	54	54
820	61 ma	79 ma	76.5 ma	44	44	44
830	64 ma	82 ma	79 ma	24	15	15
840	68 ma	85 ma	83 ma	5	-	-
845	70 ma	87 ma	85 ma	-4	-5	-5
900	75 ma	93 ma	89 ma	-19	-24	-23
915	78 ma	96 ma	93 ma	-35	-38	-37
930	80 ma	99 ma	95 ma	-44	-47	-47
945	82 ma	101 ma	98 ma	-51	-54	-53
1000	84 ma	103 ma	99 ma	-54	-58	-58
1015	85 ma	104 ma	100 ma	-58	-60	-60
1030	85 ma	106 ma	100 ma	-59	-63	-63
1045	86 ma	106 ma	100 ma	-59	-63	-63
*1100	86 ma	-	100 ma	-	-	-
1115	86 ma	106.5 ma	101 ma	-	-	-
1130	86 ma	106 ma	101 ma	-	-	-
1145	87 ma	106 ma	102 ma	-	-	-
1200	87 ma	106 ma	102 ma	-	-	-
1300	87 ma	106 ma	102 ma	-59	-63	-63
	"	"	"	"	"	"
	"	"	"	"	"	"
1630	"	"	"	"	"	"

* Changed Temperature Recorder

Before Test

	Current Drawn MA #1	#2	#3
Room Temp 74°	48 ma	65 ma	63 ma

After Test

	#1	#2	#3
Room Temp 72°	50 ma	65 ma	63 ma

APPENDIX 7

HIGH TEMPERATURE AND HIGH HUMIDITY TEST #1

Synchro Type 23TX6

Temperature +125°F
Humidity 95% RH
Time Duration 12 Days

Date	Current Drawn - MA Synchro No. #1	#2	#3	Synchro Temperature °F Synchro No. #1	#2	#3
Before Test	50 ma	65 ma	63 ma	73°F	73°F	73°F
8/20/62 PM	58-59.5	59 ma	57 ma	124°	125°	124°
8/21/62 AM	58 ma	66 ma	63 ma	125°	124°	125°
8/21/62 PM	59 ma	67 ma	65 ma	125°	126°	125°
8/22/62 AM	60 ma	68.8 ma	67 ma	125°	126°	125°
8/22/62 PM	61 ma	68 ma	66 ma	125°	126°	125°
8/23/62 AM	61 ma	68.8 ma	67 ma	125°	125°	125°
8/23/62 PM	61.5 ma	68.8 ma	67 ma	125°	125°	125°
8/24/62 AM	61.5 ma	69 ma	68.2 ma	125°	125°	125°
8/24/62 PM	61.5 ma	69 ma	68.2 ma	125°	125°	125°
8/27/62 AM	61.5 ma	68.8 ma	68.2 ma	126°	126°	126°
8/27/62 PM	61.5 ma	68.8 ma	68.2 ma	126°	126°	126°
8/28/62 AM	61.5 ma	68.8 ma	67 ma	126°	126°	126°
8/28/62 PM	61.5 ma	68.8 ma	67 ma	125°	125°	125°
8/29/62 AM	62 ma	69 ma	68.2 ma	125°	126°	125°
8/29/62 PM	62 ma	69 ma	68 ma	125°	126°	125°
8/30/62 AM	62 ma	69 ma	68 ma	126°	126°	125°
8/30/62 PM	62 ma	69 ma	68 ma	126°	126°	125°
8/31/62 AM	62 ma	69 ma	68 ma	126°	125°	125°
8/31/62 PM	62 ma	69 ma	68 ma	120°	120°	119°
After Test	58 ma	66 ma	65 ma	75°	75°	75°

APPENDIX 8

HIGH TEMPERATURE AND HIGH HUMIDITY TEST #2

Synchro Type 23TX6

Temperature +125°F
Humidity 95% RH
Time Duration 5 Days

Date	Time	Current Drawn Synchros #2	Current Drawn Synchros #4	Synchro Temperatures #2	Synchro Temperatures #4
10/29/62	820	.26 Amps	.305 Amps	106°F	100°F
"	830	.255	.30	121°	120°
"	840	.255	.30	126°	132°
"	850	.25	.30	126°	134°
"	900	.25	.30	126°	136°
"	910	.25	.295	128°	138°
"	920	.25	.295	128°	139°
"	930	.25	.30	128°	139°
"	940	.25	.30	128°	140°
"	1000	.25	.295	129°	141°
"	1100	.25	.30	129°	142°
"	1200	.25	.30	129°	144°
"	1300	.25	.30	129°	144°
"	1500	.26	.30	127°	140°
"	1600	.255	.30	128°	141°
10/30/62	827	.26	.30	126°	135°
"	930	.26	.30	127°	137°
"	1030	.26	.30	127°	138°
"	1130	.26	.30	127°	137°
"	1230	.26	.305	126°	136°
"	1330	.26	.305	127°	137°
"	1430	.255	.30	127°	138°
"	1530	.26	.30	127°	137°
"	1625	.26	.30	128°	138°
10/31/62	830	.255	.305	126°	134°
"	930	.26	.30	127°	136°
"	1130	.26	.30	127°	136°
"	*1230	.26	0-.32	127°	136°
"	1345	.26	.30	128°	140°
"	*1430	.26	0-.33	127°	137°
"	1530	.26	.30	127°	137°
"	1630	.255	.305	126°	136°

Date	Time	Current Drawn Synchros #2	#4	Synchro Temperatures °F #2	#4
11/1/62	* 830	.25 Amps	0-.30 Amps	127°F	136°F
"	940	.25	.30	128°	140°
"	* 1030	.25	0-.30	127°	138°
"	1130	.255	.305	127°	138°
"	1230	.255	.305	127°	138°
"	1330	.255	.30	127°	137°
"	1430	.25	.30	127°	137°
"	1530	.255	.30	129°	138°
"	1625	.255	.30	129°	138°
11/2/62	845	.255	.30	128°	139°
"	930	.25	.30	128°	139°
"	1130	.255	.305	127°	137°
"	1230	.255	.305	128°	139°
"	1330	.25	.30	127°	137°
"	1430	.25	.30	127°	137°
"	1530	.25	.30	128°	138°
"	1615	.25	.30	128°	139°
11/5/62	830	.26	.29	83.5°	98°

Air Temperature 78°F

* Synchro No. 4 appears to be stopping and starting.

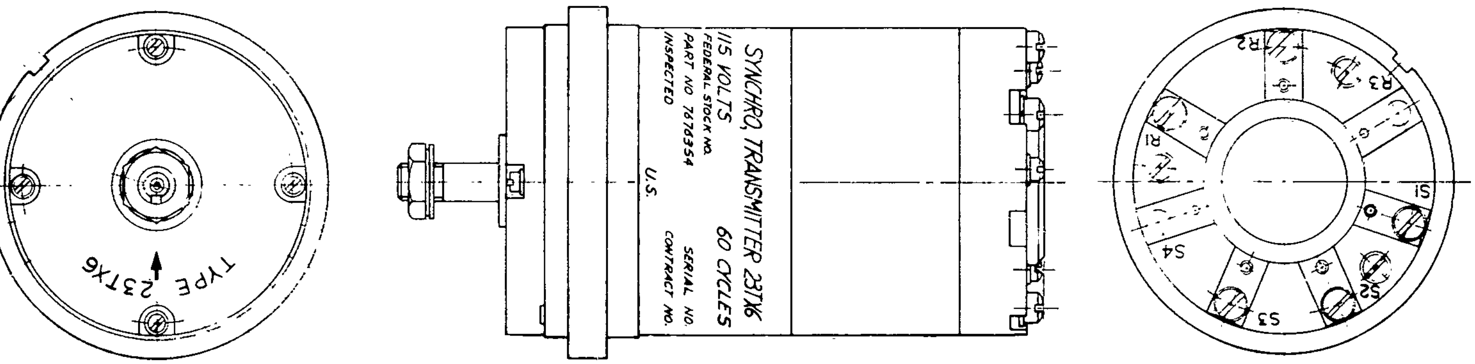

Figure 1. Synchro, Transmitter Type 23TX6 - assembled view

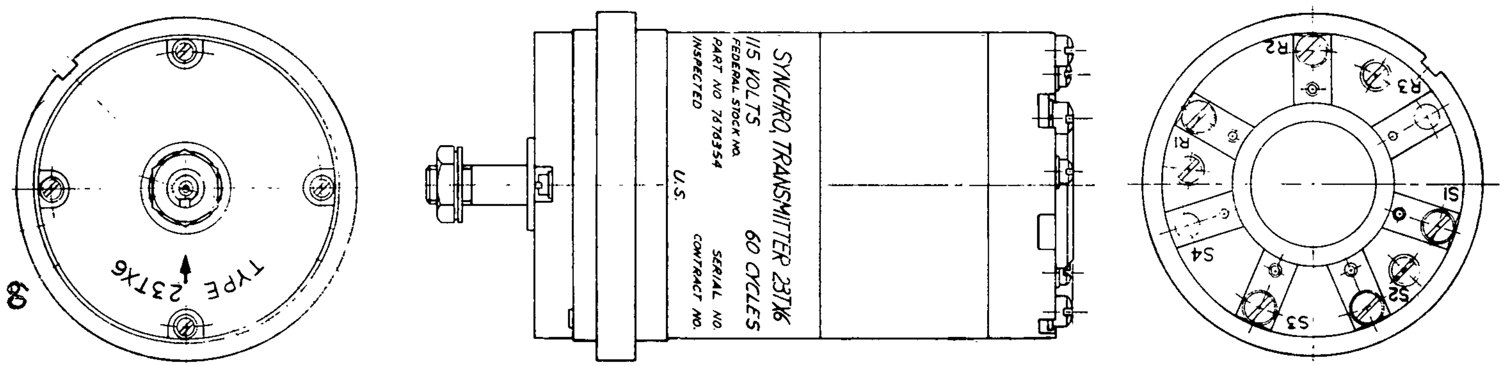

Figure 1. Synchro, Transmitter Type 23TX6 - assembled view

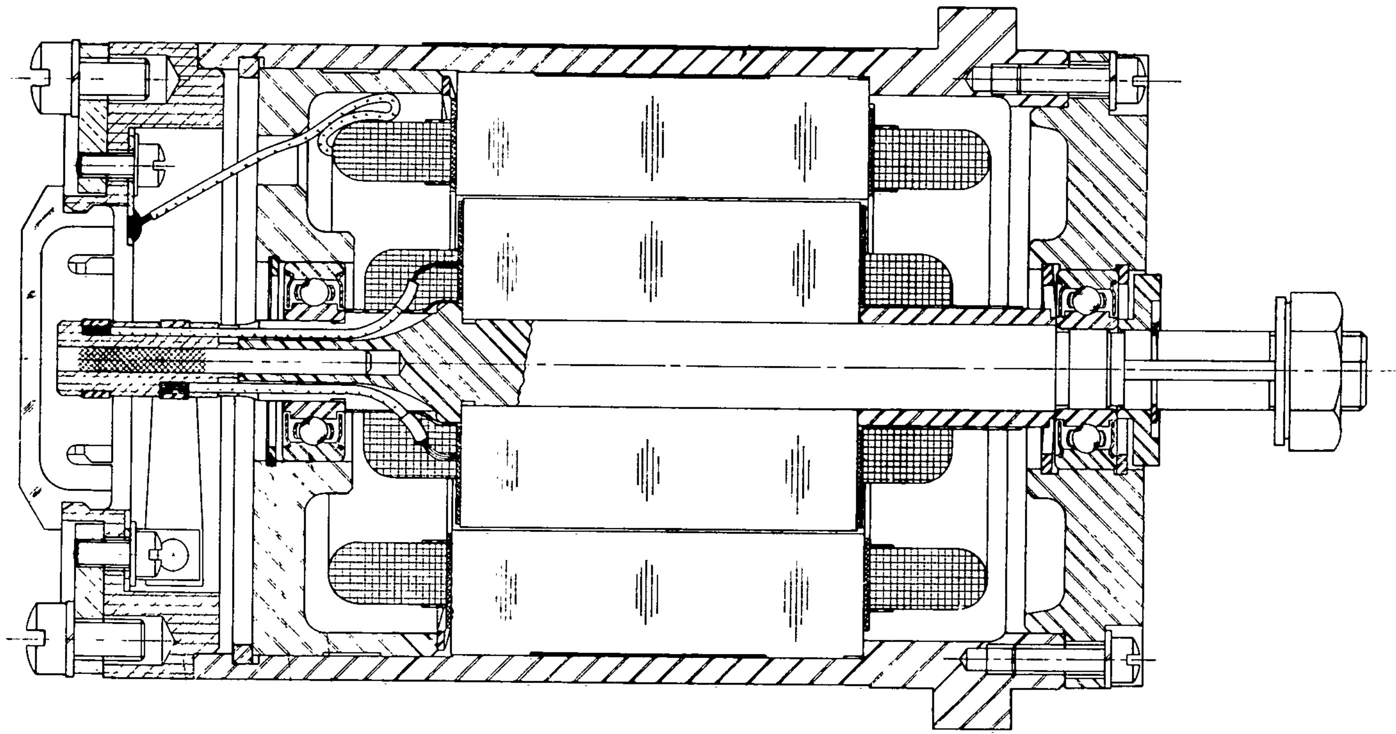

Figure 2. Synchro, Transmitter Type 23TX6 - sectioned view

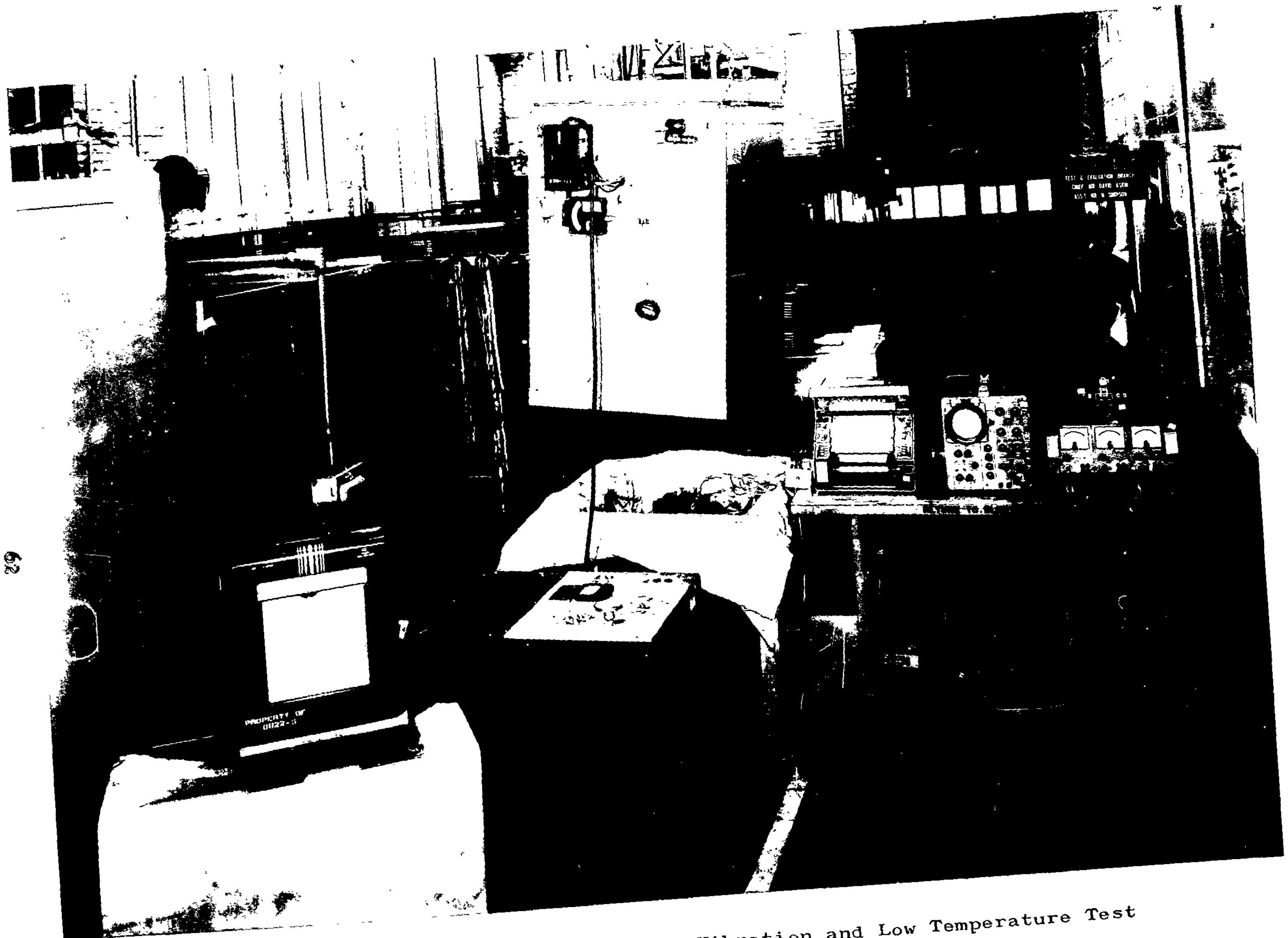

Figure 3. Typical Test Setup for Vibration and Low Temperature Test

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J.O'N. 7/10/62

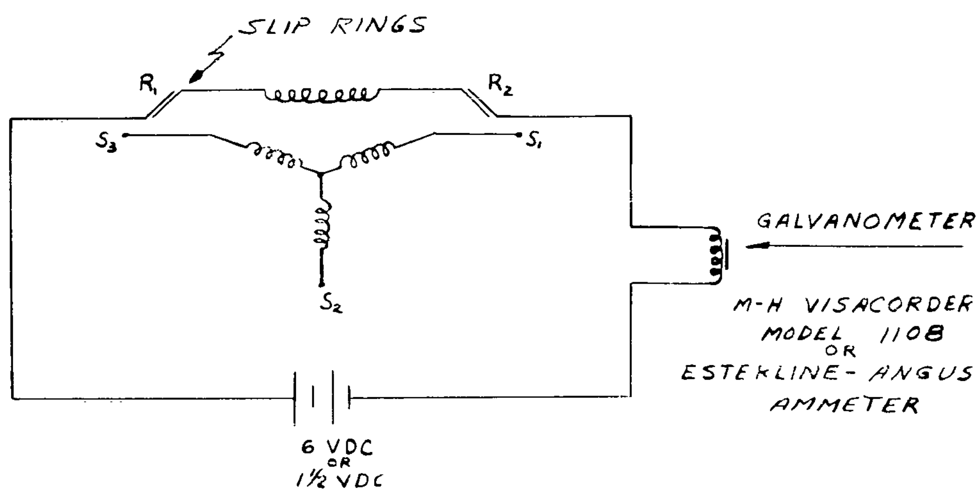

Figure 4. Schematic Diagram for Vibration and Low Temperature Test No. 1
Altitude and Low Temperature Test No. 1
High Temperature and High Humidity Test No. 1 - Synchro Type
23TX6

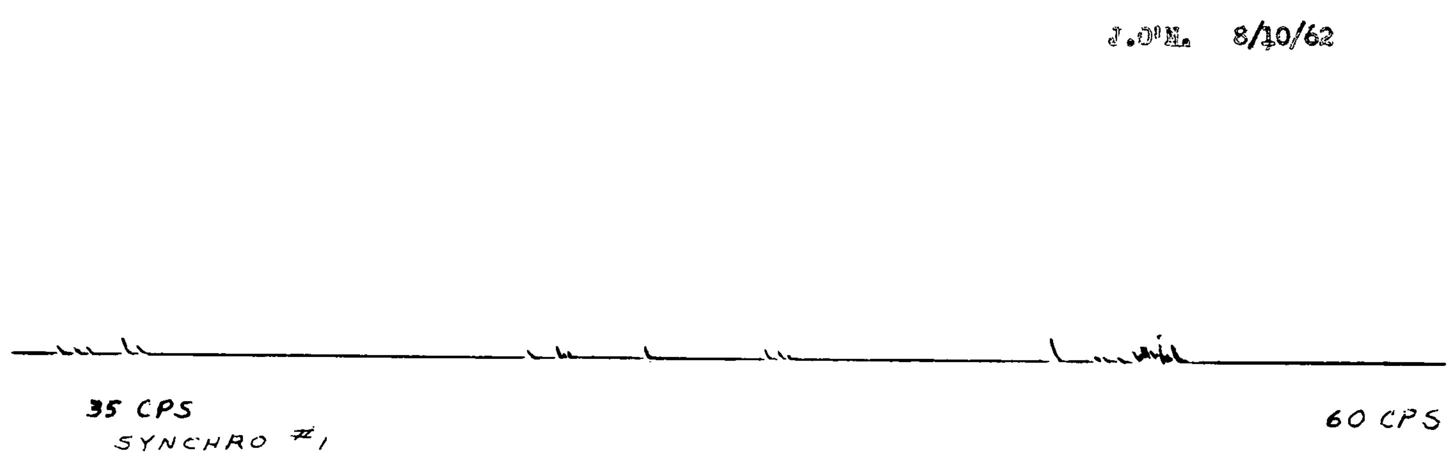

Figure 5. Vibration and Low Temperature - Test No. 1
Vibration at Ambient Temperature, Arcing at 35 to 60 cps
- 10 Aug. 62

J.O'N. 8/13/62

Figure 6. Vibration and Low Temperature - Test No. 1
Vibration at -40°F, 45 to 60 cps - 13 Aug. 62

J.O'N. 10/23/62

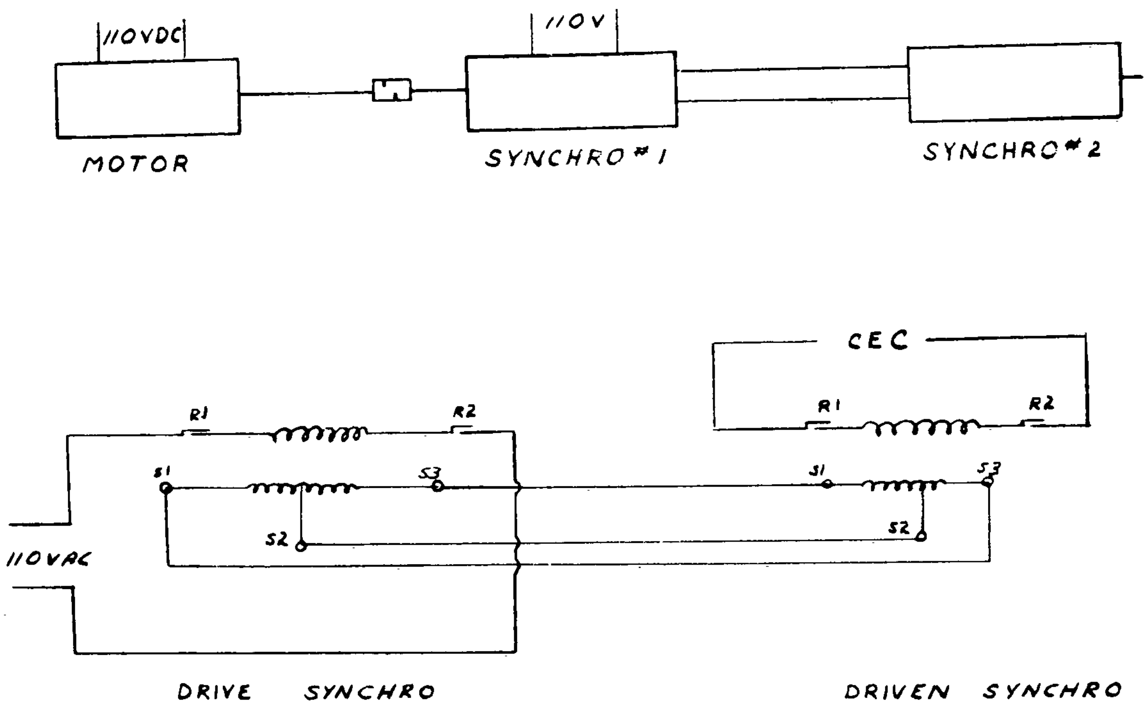

Figure 7. Electrical Setup -- Vibration and Low Temperature Test No. 2 High Temperature and High Humidity Test No. 2.

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J.O'N. 10/24/62

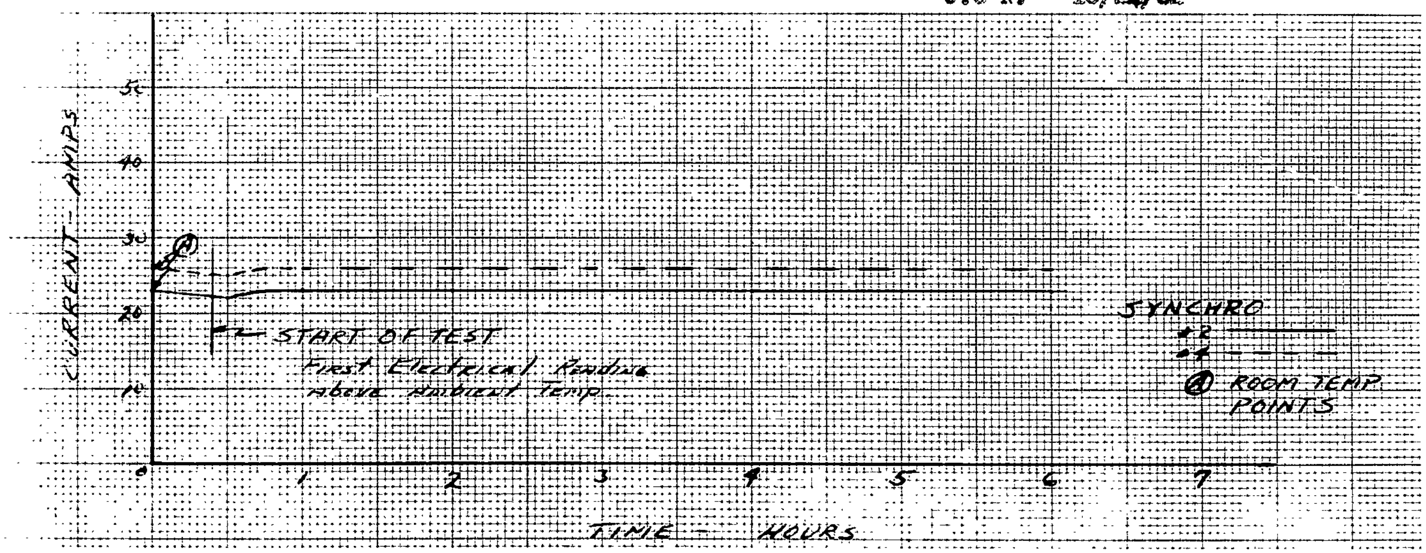

Figure 8. Vibration and Low Tempe-ature Test No. 2
Current vs. Time at -40°F, Double Amplitude 0.141",
Variable Frequency 5-60-5 cps, Vertical Vibration, Time
Duration - 6 Hrs., Synchro Type 23TX6

Figure 9. Typical Test Setup for

1. Altitude and low temperature test
2. High temperature and humidity test #1

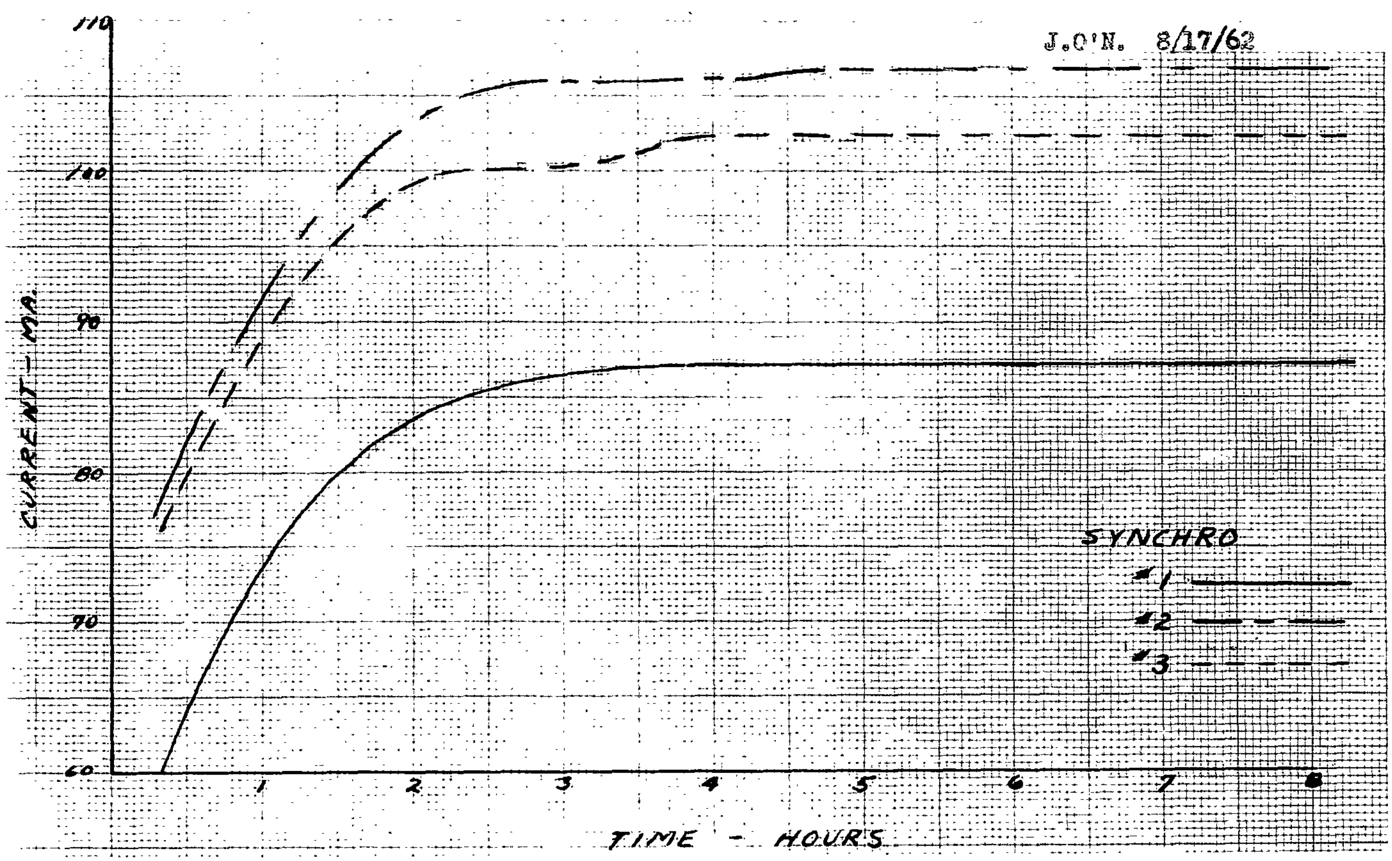

Figure 10. Current vs Time Altitude and Low Temperature - Test No. 1
10,000 Ft., Synchro Type 23Tx6, 8 Hr. Test - 17 Aug. 62

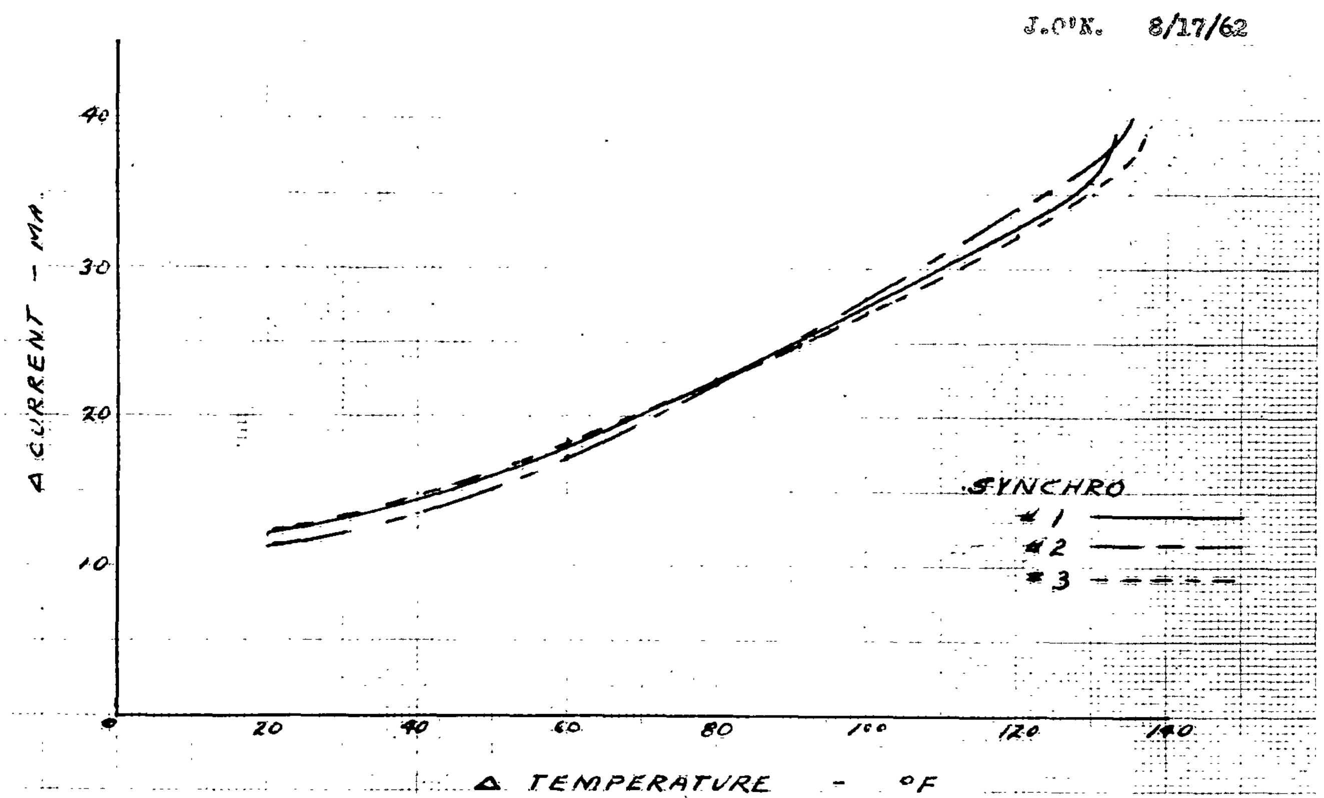

Figure 11. Δ Current vs Δ Temperature Altitude and Low Temperature - Test No. 1
10,000 Ft. - 65°F., Synchros Type 23TX6, 8 Hr. Test

J.O.N. 8/31/62

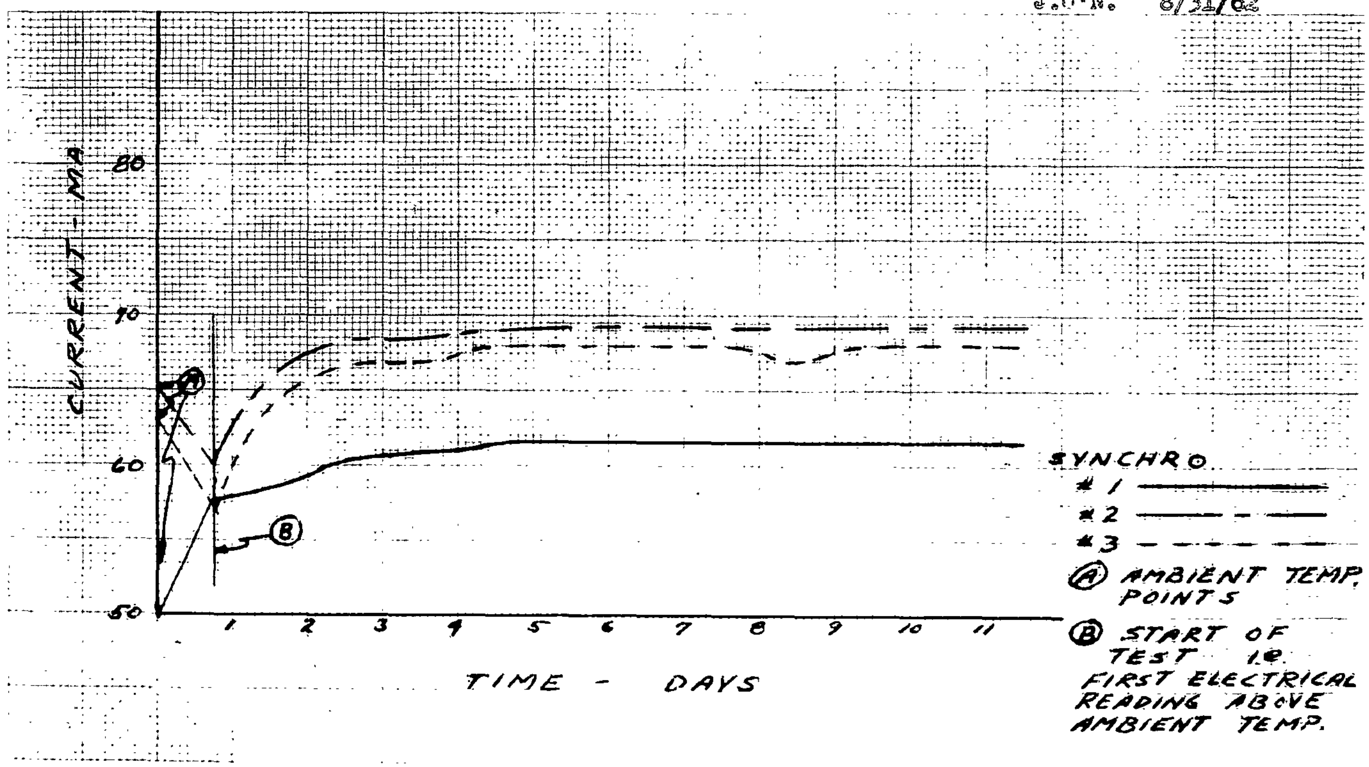

Figure 12. High Temperature and High Humidity Test No. 1
Current vs Time, 125°F - 95% RH, Synchro Type 23TX6

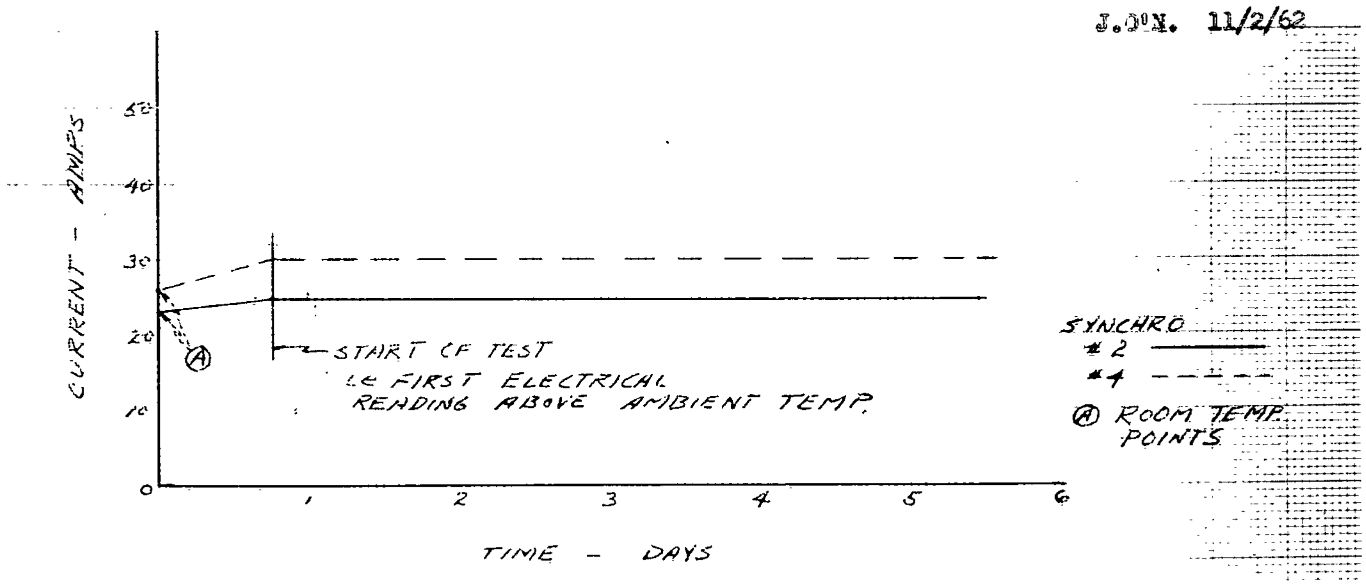

Figure 13. High Temperature and High Humidity Test No. 2
Current vs Time, 125°F - 95% RH, Synchro Type 23TX6

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